

DEPARTMENT OF AGRICULTURE.
BOTANICAL DIVISION.
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SECTION OF VEGETABLE PATHOLOGY.

PEACH YELLOWS:

A PRELIMINARY REPORT

BY

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PREPARED UNDER THE DIRECTION OF THE COMMISSIONER OF AGRICULTURE

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LETTER OF TRANSMITTAL.

SIR: I have the honor to transmit herewith the report of Mr. Erwin F. Smith, who was appointed by you as a special agent to investigate peach yellows, under the direction of this section. This report embodies the researches so far made by Mr. Smith as well as a history of the disease in this country.

Respectfully,

B. T. GALLOWAY,

Chief of the Section of Vegetable Pathology.

NORMAN J. COLMAN,

Commissioner of Agriculture.

LETTER OF SUBMITTAL.

WASHINGTON, D. C., November 10, 1888.

SIR: This preliminary report, prepared by request in advance of a report on the aetiology of the "yellows," embraces all the trustworthy information I have been able to gather during sixteen months of continuous observation and inquiry. It is too much to expect that it is entirely free from errors, but every statement has been repeatedly scrutinized, and an honest endeavor has been made to bring each one to the test of actual facts, irrespective of previous opinion.

The field work received special attention, and will, I think, throw light upon a number of important points.

Some experiments have been completed, some are now under way, and some remain to be performed. Much additional field work and a large body of very important microscopic work remain to be done before definite conclusions can be reached as to the cause of the disease. In my judgment, however, the results already obtained are sufficient to warrant the vigorous prosecution of the investigation in the field and in the laboratory, and to lead to the belief that the cause of the disease will be definitely settled in the near future.

Throughout the investigation peach growers in all parts of the country have manifested a very lively interest, and have materially facilitated my work.

Very respectfully,

ERWIN F. SMITH,
Special Agent.

To B. T. GALLOWAY,

*Chief of the Section of Vegetable Pathology,
Department of Agriculture, Washington, D. C.*

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CORRIGENDA.

Page 27, read "I. M. Smalley" for "J. McSmalley."

Page 51, the statement for Kent County, in sixth line of seventh paragraph, must be modified slightly, Charles W. Garfield having seen premature peaches due to yellows on one tree of Early Alexander, in July, 1882, on the farm of William H. Anderson, in Sparta township, 12 miles northwest of Grand Rapids. The tree was dug out, and careful search revealed no others in that orchard or elsewhere in the township.

Page 63, first foot-note, for "152 (?) car-loads" read "102 car-loads."

Page 210, second paragraph, read "one forty-fifth" instead of "one thirty-fifth."

Map IV, southeast corner, the circle printed by mistake on the yellow dot should be read on the green dot next east.

PEACH YELLOWS.

By ERWIN F. SMITH, B. Sc.

I. HISTORY AND DISTRIBUTION.

FRUITS AFFECTED, ETC.

Yellows is a disease of peaches, nectarines, almonds, and apricots. It does not occur in plums. I have myself seen it only in peaches, nectarines, and apricots, but the evidence that it also occurs occasionally in almonds is reasonably satisfactory. In apricots it is rare. The two trees which I have seen were covered with the characteristic shoots (see Photographs XXII and XXIII), but bore no fruit, so I can not tell how it might affect the latter. Noyes Darling also saw it in apricots, but did not see the diseased fruit.

The peach is most inclined to this disease, and for that reason I shall confine my study to the effects on that tree.

The name yellows was first applied to this disease, near Philadelphia, at the beginning of the century, as we shall see later. This term has passed into universal acceptance, but the origin of the malady is unknown. It was much written upon in the early part of the century and has engaged the attention of horticultural writers from that time to this. Nevertheless, its nature is but little better understood to-day than it was fifty years ago.

GEOGRAPHICAL DISTRIBUTION.

Peach yellows appears to be confined exclusively to the Eastern United States. I can find no reference to its occurrence in California or anywhere west of the Rocky Mountains, and it is doubtful if it occurs to any extent west of the Mississippi River. At least the peach growers of Kansas, Missouri, and Texas affirm that it does not occur in their orchards. To determine, positively, however, that the orchards in these States are exempt would require a careful examination by some one familiar with the disease, because where orchards are small and scattering the disease might remain localized and be overlooked for many years.

Yellows is now more or less prevalent in Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, Ohio, Michigan, and Ontario. Very likely it occurs to a considerable extent in Indiana and Illinois, and probably also to a limited extent in some parts of Kentucky, Tennessee, Georgia, and more southern States. I am not able to determine the exact southern limits of the disease. It should be said, however, that its presence is generally denied in all the Gulf States, where also it may be added that peach-raising is not an important industry. I have myself seen the disease in Pennsylvania, Delaware, Maryland, Virginia, West Virginia, and Michigan.

This disease, so far as I can determine, does not occur anywhere in Europe.¹ Whether it occurs in China, Japan, Algiers, Cape Colony, New Zealand, New South Wales, Argentine Republic, or other parts of the globe where peaches are extensively planted is a matter for future inquiry, especially with reference to the origin of the disease or to its possible introduction from this country. At present the United States appears to have exclusive possession of this most insidious and destructive disease.

EARLY HISTORY OF PEACH-GROWING IN THE UNITED STATES.

Peach yellows is not a disease of recent appearance. It has been known for some time and the literature of the subject is extensive. For a better understanding of the present situation it is desirable to learn as much as possible of its early history, and also of the early history of the peach in this country.

¹ Some of the authorities for this statement are as follows:

(1) M. Pierre Viala, of Montpellier, France. A conversation in Washington in November, 1887, at which time I showed him specimens and was told that nothing of the kind occurred in southern France or had come to his notice anywhere in Europe.

(2) Mrs. Bayle Bernard. *Our Common Fruits*. Frederick Warne & Co., London, 1886, p. 89.

(3) *The Gardeners' Chronicle*, London, 1885, p. 594. In a review of one of Professor Penhallow's papers this journal speaks of yellows in a vague way, as "This disease little known in this country."

(4) *The London Journal of Horticulture*. In 1882 this journal speaks of a new peach disease in England which it calls yellows. The account given is too imperfect to warrant any conclusion as to its real nature. *The Gardeners' Monthly*, Philadelphia, 1883, p. 15.

(5) T. D. Fish. *The Hardy Fruit Book*, London, L. Upcott Gill, 170 Strand, W. C. No date, but issued between 1880 and 1887. This author describes diseases of the peach, devoting a short paragraph to what he calls "jaundice or yellows." His account leads one to think he has in mind a yellowing of the foliage due to other causes than the disease here in question.

(6) Charles M. Hovey. *Trans. Mass. Hort. Society*, 1882, Part I, p. 131.

(7) An English Gardener. *The Gardeners' Monthly*, Philadelphia, 1880, p. 145.

(8) Prof. J. C. Holmes. *Report of the Secretary of the Michigan State Pomological Society*, 1873, p. 19.

It is uncertain exactly when peach trees were first introduced into this country, but it was prior to 1633. From two entries in the records of the Governor and Company of the Massachusetts Bay in New England,¹ it is probable that they were introduced into the New England region soon after the year 1629. On page 24 of the first volume of these records is an undated memorandum of things "to prouide to send for New England," among which are included "stones of all sorts of fruits, as peaches, plums, filberts, cherries." Somewhat later, in a letter of April 17, 1629, from Gravesend, England, by the governor and deputy of the New England Company to Capt. John Endicott, then "governor and council for London's plantation in the Massachusetts Bay in New England," we read (p. 392):

As for fruit stones and kernels, the time of the year fits not to send them now, so we purpose to do it pr. our next.

In 1633 the Dutch sea-captain, DeVries, found peach trees in Virginia in the garden of George Minifie, on the James River, between Blunt Point and Jamestown. They were the first seen by him in North America. The following is copied from the entry in his journal:

Arrived at Littletown, where Menifee lives. He has a garden of two acres, full of primroses, apple, pear, and cherry trees. * * * Around the house were planted peach trees, which were hardly in bloom.

Minifie settled there in 1623.²

In 1635 appeared the following mention of peach-growing in Maryland :

Although there be not many that do apply themselves to plant gardens and orchards, yet those that do it find much profit and pleasure thereby. They have peares,

(9) Charles Downing. *Report of the Secretary of the Michigan State Pomological Society*, 1873, p. 38. Letter of April 24, 1873.

(10) James Fitz. *The Southern Apple and Peach Culturist*, J. W. Randolph and English, Richmond, Va., 1872, p. 249.

(11) H. W. Sargent. "A visit to the London Horticultural Society's garden." *The Horticulturist*, Albany, N. Y., 1849, p. 16.

(12) Noyes Darling. *The Cultivator*. Albany, N. Y., 1846, p. 141.

(13) A. J. Downing. *Fruits and Fruit Trees of America*. New York. Page varies in different editions.

(14) In the paper by H. W. Sargent, previously cited, it is stated that Mr. Thompson, of the gardens of the Horticultural Society at Cheswick, "has seen one instance only of a disease in the peach tree resembling in its character the yellows. It was an American tree, I think a George IV, which was budded on a peach bottom and trained against a south wall. It ripened its fruit prematurely, pushed out the clusters of small narrow leaves, became quite yellow in foliage, and finally died."

(15) I have examined many English, French and German books and magazines devoted to horticulture and to diseases of plants, but in none of them have I found any account of yellows, or of any disease resembling it, although there is frequent mention of the peach and of its diseases.

¹ Vol. I. 1628-41. Edited by N. B. Shurtleff, M. D., and published by the Commonwealth. Boston, 1853.

² *The Founders of Maryland, etc.*, by Rev. Ed. D. Neill, A. B. Albany, Joel Munsell, 1876, pp. 52, 53.

apples, and several sorts of plummies, peaches in abundance, and as good as those in Italy.¹

In 1656 John Hammond wrote of an earlier period,² "Orchards innumerable were planted and preserved" (p. 9), and of his own time :

The country is full of gallant orchards, and the fruit generally more luscious and delightful than here. Witness the peach and quince. The latter may be eaten raw savourily; the former differs and as much exceeds ours as the best-relished apple we have doth the crab, and of both most excellent and comfortable drinks are made (p. 13).

Some other early statements are as follows :

In the hot summer, rock cold water, with an eighth of peach vinegar, is the best beverage : peaches better than apricots by some doe feed hogs. One man hath ten thousand trees.³

Fruits they have, strawberries, gooseberries, etc.; and for fruits brought there and planted, apples, pears, quinces, apricocks, peaches, and many more kinds excellent good, etc.⁴

In orchards [they have] all sorts of apple trees, pear trees, quince, peach, apricocks, cherries, fig trees, and vines.⁵

Mr. Scharf declares that :

All early travelers in and writers about Maryland have noted the fact that even before the first generation of settlers had passed, the country was thickly planted with orchards of apple and peach trees, which seemed to grow in the most flourishing way.

It is certainly remarkable that within twenty-two years after the landing at Saint Mary's [in 1634] orchards should have become a notable and even conspicuous feature in the landscape; but the evidence of the fact is conclusive.⁶

To the effect that previous to 1683 peach trees were growing thrifitly in considerable numbers in other parts of the country, there are statements by at least four persons, Thomas Campanius, 1643-'48;⁷ Louis Hennepin, 1679-'82;⁸ Mahlon Stacy, 1680;⁹ and William Penn, 1683.¹⁰

¹ *A Relation of Maryland.* Author unknown. Reprinted from the London edition of 1635, with a prefatory note and an appendix, by Francis L. Hawks, D. D., LL. D. New York, Joseph Sabin, 1865. p. 28.

² *Leah and Rachel; or the Two Fruitful Sisters, Virginia and Maryland,* by John Hammond. London, 1656. Reprinted in Force's *Historical Tracts.* Vol. 3. Washington, D. C., 1844.

³ *A Description of the Province of New Albion* [in North Virginia], etc. 1648. Reprinted in Force's *Historical Tracts.* Vol. II.

⁴ *A Perfect Description of Virginia,* etc. London, 1649. Force's *Historical Tracts.* Vol. II.

⁵ *A True Relation of Virginia and Maryland,* by Nathaniel Shrigley. London, 1669. Force. Vol. III.

⁶ *History of Maryland,* by J. Thomas Scharf. Baltimore, 1879. Vol. I, p. 6.

⁷ *A short account of New Sweden* (in Swedish). Stockholm, 1702. Cf. a synopsis in *Tr. Am. Philosophical Soc., Phila.,* 1816; and a translation by Du Ponceau, Phila., 1834.

⁸ *Nouvelle découverte d'un très grand pays, situé dans l'Amérique, entre le Nouveau Mexique et la Mer Glaciale* etc. Utrecht, 1697, p. 300, and elsewhere.

⁹ *History of Pennsylvania in America,* etc., by Robert Proud. Philadelphia, 1797, Vol. I, p. 153; *History of New Jersey,* by John O. Raum, p. 108. Stacy's letter was written from "Falls of the Delaware," April 26, 1680, to his brother Revell and others in England.

¹⁰ "History of the Peach in America," Loren Blodgett. *The Gardeners' Monthly,* Philadelphia, 1882, p. 347; see also Proud's *History of Pennsylvania in America,* Vol. I, p. 249.

Campanius records finding peaches in three places along the Delaware. Hennepin says:

The peaches there [in Louisiana] are like those of Europe and bear very good fruit in such abundance that the savages are often obliged to prop up the trees with forked sticks.

Du Pratz thinks it probable that peaches were introduced into Louisiana by the Indians prior to French occupation; the aborigines having obtained them from the English colony in Carolina. This is the most probable origin of those found by Hennepin, De Soto's visit to the Mississippi one hundred and fifty years before having been under conditions not at all favorable either to the transportation or the planting of peach pits.

Stacy writes from New Jersey:

I have traveled through most of the places that are settled, and some that are not; and in every place I find the country very apt to answer the expectation of the diligent. I have seen orchards laden with fruit to admiration; their very limbs torn to pieces by the weight, and most delicious to the taste and lovely to behold. I have seen an apple tree from a pippin kernel yield a barrel of curious cider, and peaches in such plenty that some people took their carts a peach gathering: I could not but smile at the conceit of it; they are very delicate fruit, and hang almost like our onions that are tied on ropes.

William Penn says:

The fruits I find in the woods are white and black mulberry, chestnut, walnut, plums, strawberries, cranberries, hurtleberries, and grapes of divers sorts. * * * Here are also peaches and very good and in great quantities, not an Indian plantation without them; but whether naturally here at first I know not. However, one may have them by bushels for very little; they make a pleasant drink and I think not inferior to any peach you have in England, except the true Newington.¹

According to Robert Beverly² peaches grew abundantly in Virginia at the beginning of the eighteenth century. He says:

Peaches, nectarines, and apricots, as well as plums and cherries, grow there upon standard trees. They commonly bear in three years from the stone, and thrive so exceedingly that they seem to have no need of grafting or inoculating, if anybody would be so good a husband: and truly I never heard of any that did graft either plum, nectarine, peach, or apricot in that country, before the first edition of this book [London, 1705].

Peaches and nectarines I believe to be spontaneous somewhere or other on the continent, for the Indians have, and ever had, greater variety and finer sorts of them than the English. The best sort of these cling to the stone and will not come off clear, which they call plum nectarines and plum peaches, or clingstones. Some of these are 12 or 13 inches in the girth.³ These sorts of fruits are raised so easily there that

¹ Wm. Penn, proprietor and governor of Pennsylvania, first landed in America in October, 1682. The long descriptive letter from which this paragraph is taken was written August 16, 1683, from Philadelphia "To the Committee of the Free Society of Traders of that province, residing in London."

² *The History of Virginia*, by Robert Beverly, a native and inhabitant of the place. Reprinted from the author's second revised edition, London, 1722. J. W. Randolph, Richmond, Va., 1855, p. 259.

³ In August, 1887, I received two Pullen's Seedlings from John Burnite, of Felton, Del., which measured respectively 9 $\frac{1}{2}$ and 9 $\frac{3}{4}$ inches; and in August, 1888, I saw a Reeves's Favorite, 10 inches in circumference.

some good husbands plant great orchards of them, purposely for their hogs; and others make a drink of them, which they can mobby, and drink it as cider, or distil it off for brandy. This makes the best spirit next to grapes.

In 1733 peaches grew plentifully in Georgia, as indicated by the following quotation:¹

Mulberries, both black and white, are natives of this soil, and are found in the woods, as are many other sorts of fruit trees of excellent kinds, and the growth of them is surprisingly swift: for a peach, apricot, or nectarine tree will, from the stone, grow to be a bearing tree in four or five years' time [p. 50].

They have oranges, lemons, apples, and pears, besides the peach and apricot mentioned before. Some of these are so delicious that whoever tastes them will despise the insipid, watery taste of those we have in England; and yet such is the plenty of them that they are given to the hogs in great quantities (p. 51).

On September 18, 1740, Mr. Thomas Jones writes from Savannah to Mr. John Lyde as follows:²

As to our fruit, the most common are peaches and nectarines (I believe that I had a hundred bushels of the former this year in my little garden in town): we have also apples of divers sorts, chineopin nuts, walnut, chestnut, hickory, and ground nuts.

In 1741 Sir John Oldmixon writes of Virginia:³

Here is such plenty of peaches that they give them to their hogs; some of them, called malachotoons, are as big as a lemon and resemble it a little.

Of Carolina he writes, quoting Mr. Archdale:

Everything generally grows there that will grow in any part of Europe, there being already many sorts of fruits, as apples, pears, apricots, nectarines, etc. They that once taste of them will despise the watery, washy taste of those in England. There's such plenty of them that they are given to the hogs. In four or five years they come from a stone to be bearing trees.

In 1748 the naturalist, Peter Kalm, traveled extensively in Pennsylvania, New Jersey, and other parts of eastern North America. Kalm was a shrewd and observant man. From his interesting records, which bear the stamp of truth, I quote as follows:⁴

[September 17, 1748, at Mr. Bartram's country seat, 4 miles south of Philadelphia]: Every countryman, even a common peasant, has an orchard near his house, in which all sorts of fruits, such as peaches, apples, pears, cherries, and others are in plenty. The peaches are now almost ripe. They are rare in Europe, particularly in Sweden, for in that country hardly any people besides the rich taste them. But here every countryman had an orchard full of peach trees, which were covered with such quantities of fruit that we could scarcely walk in the orchards without treading on those which were fallen off, many of which were always left on the ground, and only part of them was sold in town and the rest was consumed by the family and strangers, for every one that passed by was at liberty to go into the orchard and to gather as many

¹ *A New and Accurate Account of the Provinces of South Carolina and Georgia*. London, 1733. Said to be by General Oglethorpe. Reprinted in *Collections of the Georgia Historical Society*. Vol. I, Savannah, 1840.

² *An impartial inquiry into the state and utility of the province of Georgia*. London: 1741. Presumed to be by Benjamin Martin, esq. Reprinted in *Collections of the Georgia Historical Society*, Vol. I, 1840, p. 199.

³ *The British Empire in America*, by John Oldmixon. Second edition, London: 1741. Vol. I, pp. 440 and 515.

⁴ *Travels into North America*, by Peter Kalm; translated into English by John R. Forster, F. A. S. Warrington: 1770. Vol. I.

of them as they wanted. Nay, this fine fruit was frequently given to the swine (pp. 71-72).

[Here follows a paragraph telling how the fruit is dried for winter use.]

The peach trees have, as I am told, been first planted here by the Europeans. But at present they succeed very well, and require even less care than our [Swedish] apple and pear trees.

The orchards have seldom other fruit than apples and peaches (p. 73).

[September 21. Nine miles northwest of Philadelphia, at the country-seat of Mr. Peter Cock]: As we went on in the wood we continually saw at moderate distances little fields, which had been cleared of the wood. Each of these was a farm. * * * Every countryman, even though he was the poorest peasant, had an orchard, with apples, peaches, etc. (p. 88).

[September 22, same locality]: They make brandy from peaches here after the following method. * * * This brandy is not good for people who have a more refined taste, but it is only for the common kind of people, such as workmen and the like (p. 94).

[September 26]: Mr. Bartram was of the opinion that the apple tree was brought into America by the Europeans, and that it never was there before their arrival. But he looked upon peaches as an original American fruit, and as growing wild in the greatest part of America. Others again were of the opinion that they were first brought over by the Europeans. But all the French in Canada agreed that on the banks of the Mississippi and in the country thereabouts peaches were found growing wild in great quantity (p. 127).

October the 27th. In the morning I set out [from Philadelphia] on a little journey to New York, in company with Mr. Peter Cock, with a view to see the country, and to inquire into the safest road which I could take in going into Canada.¹ * * *

That part where we traveled at present [*i. e.*, on the west bank of the Delaware, between Philadelphia and Trenton] was pretty well inhabited on both sides of the road by Englishmen, Germans, and other Europeans. * * * Near almost every farm was a great orchard, with peach and apple trees, some of which were yet loaded with fruit (p. 216).

Kalm crossed the Delaware at Trenton in the evening, and continued his journey on October 28, from Trenton via Princeton, where they stopped over night. He found the country thickly settled and full of orchards:

During the greater part of the day we had very extensive corn fields on both sides of the road. * * * Near almost every farm was a spacious orchard full of peach and apple trees, and in some of them the fruit had fallen from the trees in such quantities as to cover nearly the whole surface. Part of it they left to rot, because they could not take it all in and consume it. Wherever we passed by we were always welcome to go into the fine orchards and gather our hats and pockets full of the choicest fruit, without the possessors so much as looking after it (pp. 222-223).

On October 29 the journey was continued via New Brunswick:

Almost near every farm-house were great orchards (p. 227).

In 1758 Du Pratz speaks of peaches in Louisiana as follows:²

The peaches are of the kind we call alberges; and contain so much water that they

¹ Later, when Kalm was in Canada, he notes the reported occurrence of peaches in the southern parts of Canada and to the southwest in the Mississippi region, but makes no mention of having himself seen them in Canada.

² *The History of Louisiana, or of the western parts of Virginia and Carolina*, translated from the French (lately published), by M. Le Page Du Pratz. London, 1763. Vol. II., p. 17.

make a kind of wine of it. * * * Our colonists plant the peach stones about the end of February, and suffer the trees to grow exposed to all weathers. In the third year they will gather from one tree at least two hundred peaches, and double that amount for six or seven years more, when the tree dies irrevocably. As new trees are so easily produced, the loss of the old ones is not in the least regretted.

In 1756 Israel Acerlius returned to Sweden from the Delaware region, where he had been the resident clergyman for some years. From his book, which is more trustworthy than that of Campanius, I quote as follows:¹

Peach trees stand within an inclosure by themselves; grow even in the stoniest places without culture. The fruit is the most delicious that the mouth can taste, and often allowable in fevers. One kind, called clingstones, are considered the best; in these the stones are not loose from the fruit as in the others. Many have peach orchards chiefly for the purpose of feeding their swine, which are not allowed to run at large. They first bloom, in March, the flowers coming out before the leaves, and are often injured by the frosts; they are ripe toward the close of August. This fruit is regarded as indigenous, like maize and tobacco: for as far as any Indians have been seen in the interior of the country these plants are found to extend.

In one of his chapters on the "General state of Pennsylvania between the years 1760 and 1770," Proud says:²

In some places peaches are so common and plentiful that the country people feed their hogs with them.

In 1793 Thomas Cooper spent the autumn and winter in the United States, and on his return to England published a book in which are the following statements, apparently in part, at least, gathered at first hand:³

Every farm home in the Middle and Southern States has its peach orchard and its apple orchard, and, with all their slovenliness, abundance and content are evident in every habitation (p. 51).

At Norfolk, Va., peaches sold for 1*d.* and 2*d.* per dozen (p. 96). At Winchester, Va., the price of peaches was from 2*s.* to 4*s.* per bushel, Virginia currency (p. 100).

In Virginia and Maryland peaches and apples afford peach and apple brandy: the latter is an indifferent spirit: the former, when well made, carefully rectified, and kept in a cask for some years, is as fine liquor as I have ever tasted (p. 121).

At Paxton, near Harrisburg, Mr. M'Allister had several peach trees but only recently planted. This man also had a few apricot and nectarine trees.

He gives 6*d.* a piece for apple and peach trees, about three or four years old, that is fit to plant out (p. 129). Peach trees [same place] grow about the thickness of one's thumb and 4 or 5 feet high in one year from the stone, and bear fruit in four years from the stone (p. 130).

In 1795 Winterbotham writes:⁴

The apples of this State [Maryland] are large but mealy: the peaches plenty and good. From these the inhabitants distill cider and peach brandy (p. 36).

¹ *The History of New Sweden, or the Settlements on the River Delaware*, by Israel Acerlius. Stockholm, 1759. Translated from the Swedish by William M. Reynolds, D. D., Philadelphia, 1876, being Vol. XI of the *Memoirs of the Historical Society of Pennsylvania*. Pp. 151, 152.

² *L. o.*, Vol. II, p. 266.

³ *Some Information Respecting America*, collected by Thomas Cooper, late of Manchester. London, 1794.

⁴ *An Historical, Geographical, Commercial, and Philosophical View of the American United States, etc.*, by W. Winterbotham. London, 1795. Vol. III.

In some counties [of Virginia] they have plenty of cider, and exquisite brandy distilled from peaches, which grow in great abundance upon the numerous rivers of the Chesapeake (p. 84).

Little attention appears to have been given to the systematic cultivation of the peach even during the eighteenth century. The trees were transplanted, or grown in place from pits, and then left to themselves. Even as late as 1804 such treatment was not infrequent.¹ Nevertheless the peach flourished.

FIRST APPEARANCE OF YELLOWS.

However, in the vicinity of Philadelphia and along the Delaware, where from past experience the climate was known to be very favorable, more attention was given to peach orchards after the Revolution; and here, prior to 1800, there began to be great complaint of the increasing degeneracy of the peach. In marked contrast with its former habit it was now declared to be very short-lived and disappointing. So general was this decay that in May, 1796, the American Philosophical Society offered the following premium, one of five:

For the best method, verified by experiment, of preventing the premature decay of peach trees, a premium of \$60. Papers on this subject will be received till the 1st day of January, 1798.²

This premium was finally divided between John Ellis, of New Jersey, and Thomas Coulter, formerly of Delaware but then of Bedford County, Pa. Both men associated the trouble directly or indirectly with insects,³ and Mr. Ellis gives a rough but fairly correct account of the depredations of the borer, *Egeria exitiosa*, Say. There is no mention in either paper of any symptoms at all like yellows.

It does not appear that the peach borer was responsible for the entire trouble, though unquestionably the habits of this insect have not changed during the last hundred years.

Ten years later, February 11, 1806, Judge Richard Peters read before the Philadelphia Society for Promoting Agriculture⁴ a paper "on peach trees," in which he says:

About fifty years ago [between 1750 and 1760], on the farm on which I now reside [Belmont, now included in Fairmount Park in the west part of Philadelphia], my father had a large peach orchard, which yielded abundantly. Until a general catastrophe befell it plentiful crops had been for many years produced with very little attention. The trees began nearly at once to sicken, and finally perished. Whether by the wasp [*Egeria*] then undiscovered, or by some change in our climate, I know

¹ *An Epitome of Mr. Forsyth's Treatise on the Culture and Management of Fruit Trees. By an American Farmer.* Phila., 1804.

² *Tr. Am. Philosophical Soc.*, Phila., 1799, Vol. IV, p. 5.

³ *Tr. Am. Philo. Soc.*, Phila., Vol. V, Appendix, pp. 325-328.

⁴ *Memoirs of the Philadelphia Society for Promoting Agriculture*, Phila., Pa., 1815, pp. 15-24.

not.¹ For forty years past I have observed the peach trees in my neighborhood to be short-lived. Farther south, in the western country, and, it seems, in some parts of New Jersey [apparently not in all] they are durable and productive as they had been formerly here. * * * The worm or grub, produced by the wasp depositing its progeny in the soft bark near the surface of the ground, is the most common destroyer. * * * When trees become sickly I grub them up. I find that sickly trees often infect those in vigor near them by some morbid effluvia. Although I have had trees twenty years old, and knew some of double that age (owing probably to the induration of the bark rendering it impervious to the wasp, and the strength acquired when they had survived early misfortunes), yet in general they do not live in tolerable health after bearing four or five crops. * * * Fifteen or sixteen years ago [1790-'91] I lost one hundred and fifty peach trees in full bearing in the course of two summers by a disease engendered in the first season. I attribute its origin to some morbid infection in the air. * * * The disorder being generally prevalent would, among animals, have been called an epidemic. From perfect verdure the leaves turned yellow in a few [?] days, and the bodies blackened in spots. Those distant from the point of infection gradually caught the disease. I procured young trees from a distance in high health and planted them among the least diseased. In a few [?] weeks they became sickly, and never recovered. * * * After my general defeat and most complete overthrow, in which the worm had no agency, I recruited my peaches from distant nurseries, not venturing to take any out of those in my vicinity. I have since experienced a few instances of this malady, and have promptly, on the first symptoms appearing, removed the subjects of it, deeming their cases desperate in themselves and tending to the otherwise inevitable destruction of others.

Judge Peters said he then had two hundred trees of all ages—thirty-two varieties; Mr. Coxe, of Burlington, N.J., had “double that number,” and Edward Heston, a neighbor of Peters, had “seven or eight hundred trees * * * now in vigor, and very productive.” On page 23 Judge Peters adds, in a note of later date:

Mr. Heston begins to suffer by the disease I call the yellows, though he has fewer worms than common in other modes [of cultivation].

Nearly two years later, September, 1807,² Judge Peters records in a brief note, that—

As I predicted, the yellows are seen making destructive ravages in Mr. Heston's peach plantation. I have lost a great proportion of my trees [the 200] by the same malady this year, some of them young and vigorous. We have had two successive rainy seasons. I do not recollect ever to have seen more general destruction among peach trees throughout the whole of the country. It seems that excessive moisture is one of the primary causes of this irresistible disease.

Again we read:³

I am pursuing my old plan of re-instating my peach trees lost last season [1806 or 1807] by my unconquerable foe, the disease I call the yellows. I obtain them from different nurseries free from this pestiferous affection. The worm or wasp [*Egeria*]

¹ In *The New England Farmer, or Geographical Dictionary*, Worcester, Mass., 1790, Samuel Dean also complains of a degeneracy of peach trees dating back to about 1760. His statements are as follows: “We have room for making great improvements, it seems, in the culture of this fruit. What we call the rare-ripe is almost the only sort I have seen that is worth cultivating. And this kind within thirty years seems to have greatly degenerated. I apprehend it is time that these were renewed by bringing the trees or stones from some other country.” (P. 208.)

² *Memoirs of the Philadelphia Society for Promoting Agriculture*, Phila., Pa., 1815, p. 24.

³ *Ibid.*, p. 120.

I have in complete subjection. I should be perfectly disinterested in proposing that the society offer a premium for preventing the disease so fatal; for I shall never gain the reward.

Again Judge Peters writes:

I still think [November 17, 1807]¹ that the disease so generally fatal (more so this year than any other in my memory), called the yellows, is atmospherical. * * * Compare this account [of thrifty orchards in Delaware] with the actual state of the peach in our country, and judge whether we live in a region favorable to its growth. Mr. Heston's attempt at cultivating this tree in the Southern manner begins already to fail. His trees are evidently infected, and many are on the decline. The yellows are universally prevalent this season throughout the whole country [*i. e.*, around Philadelphia].

It is to be regretted that with all his writing Judge Peters left no clear account of the symptoms of the disease. There is nothing more definite than the following remark:

The shoots of the last season were remarkably injured by the excessive drought, and the extremities of many limbs are entirely dead [February 11, 1806]. Teguments of straw or bass [placed around the trunk to keep away the borers] made the bark tender and it threw out under the covering sickly shoots.

This incidental mention of "sickly shoots" and dead extremities, coupled with the other statements quoted, render it likely enough that the appearances which he attributed to other causes were really due to what we now call yellows. So far as I know, Judge Peters was the first to apply the term yellows to a disease of the peach.

Dr. James Tilton, of Bellevue, near Wilmington, Del., expresses himself more explicitly and leaves no doubt that the disease which he saw was identical with the one now prevalent. In a letter to Judge Peters, November 6, 1807,² he says:

The disease and early death of our peach trees is a fertile source of observation, far from being exhausted. * * * Even that sickly appearance of the tree called the yellows, attended by numerous weakly shoots on the limbs generally, is attributed to insects by a late writer in our newspapers.

There is no mention of premature fruit, associated with the "weakly shoots" as a part of the disease, but, as an effect of climate, mention is made that "a fine early peach, which ripened in Northampton, Va., so early as June, did not ripen on my farm before the last of August or the first of September." In the same communication Dr. Tilton speaks of "measures proposed in our newspapers for curing the yellows," as though the disease had become general.

I have no doubt that Doctor Tilton saw yellows in 1807, and am strongly inclined to think that Judge Peters was talking about the same disease. Clearly Doctor Tilton thought so. This would put back the first appearance of peach yellows to some time prior to 1791.

Returning to 1806-'07 we may inquire to what extent this new disease was prevalent. The foregoing citations show clearly enough the condition of orchards around Philadelphia.

¹ *Memoirs of the Philadelphia Society for Promoting Agriculture*, Phila., Pa., 1815, p. 189.

² *Ibid.*, pp. 192-197.

Mr. William Coxe, a nurseryman and fruit-grower who lived at Burlington, N. J., 20 miles northeast of Philadelphia, writes to Judge Peters on April 5, 1807:¹

I am perfectly ignorant of the disease to which you give the name of yellows. Nothing of this description has ever appeared among my peach trees. For four or five years past my trees have borne well and have resisted the worms.

Doctor Tilton writes to Judge Peters:²

In my jaunt through Maryland I was attentive to the subject of your letters. I found the peach trees generally were long-lived, healthy, and bore well. In Edward Lloyd's garden [at Wye House, near Tunis Mills, Talbot County] I observed some of these trees 15 or 18 inches in diameter and perfectly healthy. Colonel Nichols, near Easton [Talbot County, 95 miles southwest of Philadelphia], abounds in the best kind of peaches.³ He is an old residenter, and particularly attentive to fruits.

In reference to Delaware, Judge Peters himself says:⁴

I received verbally from a wealthy farmer, Mr. Bellab, who is the proprietor of a considerable landed estate in Delaware [near Dover], the following account, which he says is generally applicable to the culture of peaches in the southern country:

"In Kent County, Del., they cultivate the peach without any difficulty or risk. * * * They obtain fruit in three years in plenty; and the trees have been known to endure fifty years. No worms or diseases assail them. * * * There are orchards of 50 and 70 acres, and some larger in Accomac⁵ and other parts of the isthmus between the bays of Chesapeake and Delaware, farther south."

Timothy Matlack, esq., writing "On Peach Trees" in 1808,⁶ from Lancaster, 65 miles west of Philadelphia, speaks of the borer, but does not mention yellows.

It would appear, therefore, from these statements and from considerable additional negative evidence, that at this date, 1806-'07, the disease was restricted to a small area around Philadelphia, including probably a portion of New Jersey and upper Delaware.

¹ *Memoirs of the Philadelphia Society for Promoting Agriculture*, Phila., Pa., 1815, p. 120.

² *Ibid.*, p. 196.

³ "This tree was introduced at Easton, Talbot County, Md., by George Robbins, in about 1735. The stones were received by [him from] Peter Collinson, of England, together with the seeds of that year."—*The Southern Apple and Peach Culturist*, by James Fitz and J. W. Fitz, Richmond, Va., 1872, p. 225.

⁴ *Memoirs of the Philadelphia Society for Promoting Agriculture*, Phila., Pa., 1815, pp. 189, 190.

⁵ In 1814 Mr. Bayley, of Accomac County, had 63,000 peach trees, the product of which he converted into brandy. He had then been in the business more than ten years. "The age of a peach orchard Mr. Bayley estimates at twenty years. He has seen them much older, but thinks more profit is to be had by replanting at the end of twenty years. A tree is nearly in perfection the sixth year, when it will yield annually at the rate of 15 gallons of fourth-proof brandy for every hundred trees. The price of this liquor before the war [of 1812] was \$1.50, and now \$2 per gallon." Peach borers were common, but there is no mention of any disease.—Quoted from Mr. Geddes in *The Farmer's Assistant*, by John Nicholson, esq., of Herkimer, N. Y., published by Benjamin Warner, Philadelphia and Richmond, 1820.

⁶ *Memoirs of the Philadelphia Society for Promoting Agriculture*, Phila., Pa., 1815, pp. 278-284.

From this date the disease gradually extended into New Jersey, Delaware, Maryland, New York, and other States.

Mr. Coxe, of New Jersey, who knew nothing about yellows in 1807, knew it apparently only too well in 1817,¹ for he says of the peach :

It is, when in perfection, the finest fruit of our country for beauty and flavor; it is deeply to be regretted that its duration is so short, and that it is subject to a malady which no remedy can cure nor cultivation arrest. Of the numberless modes of mitigating or preventing the diseases of the peach tree, with which our public prints are daily teeming, none have yet been found effectual. The ravages of the worm, which destroys the roots and trunk of this tree, may be sometimes prevented and with care may be at all times rendered less destructive, but the malady which destroys much the largest portion of the trees has hitherto baffled every effort to subdue it; neither its source nor the precise character of the disease appear to be perfectly understood. In one of the consequences of this disease every cultivator of the tree will agree, that it can not be cultivated with success on the site of a former plantation until some years and an intermediate course of cultivation have intervened; in a nursery established on ground previously occupied by peach trees the stones may possibly sprout, but in a few [?] weeks they will assume a languishing appearance, the leaves will turn yellow, they will dwindle, and the greater part will perish the first season.

If trees are brought from a sound nursery and planted on the site of an old orchard, or in a garden previously occupied by them, or among old trees, the young plantation will share the same fate with the nursery plants, it will seldom survive the first season, and it will never be vigorous or thrifty.

The fine peaches which are raised for the Philadelphia market are cultivated in the following manner. [Here follows an account of the method of cultivation, not different from that now in use in Maryland and Delaware.] With this management [which included search for borers in the spring, summer, and autumn], a peach orchard near a market, or on navigable waters, will be a profitable application of land, but no precautions will insure its duration beyond two or three, or at the utmost four [bearing?] years. If it succeeds even for this short time, with a judicious selection of kinds, the product will amply remunerate the trouble and expense, beyond any other mode of employing the land in this country.

The proper soil for a peach orchard is a rich sandy loam: I have no recollection of a very productive one on very stiff or cold land.

As early as 1810, according to Darling,² and 1814, according to Downing,³ the disease had already destroyed "a considerable part of all the orchards" in New Jersey, and had made its appearance on the banks of the Hudson and in Connecticut.⁴

Mr. Coxe in his treatise—all the pertinent portions of which I have quoted—does not mention premature fruit. The earliest reference to this as one of the symptoms of yellows is by William Prince, of Flushing, Long Island, in 1828. Mr. Prince was a famous nurseryman. His extensive knowledge of theoretical and practical horticulture, together

¹ *A View of the Cultivation of Fruit Trees, etc.*, by Wm. Coxe, esq., of Burlington, N. J., pp. 215-217. Phila., 1817.

² *The Yellows in Peach Trees*, by Noyes Darling, New Haven, Conn., December 2, 1844. *The Cultivator*, Albany, N. Y., 1845, pp. 60-62.

³ *Fruits and Fruit Trees of America*, by A. J. Downing. Revised edition, N. Y., 1865, p. 600.

⁴ See also Nil s's *Weekly Register*, Baltimore, Md., 1816, p. 262, and *Farmers' Register*, Pittsburgh, Va., 1841, pp. 357-8.

with his good general knowledge of botany, not only made him familiar with the disease, but fitted him to write upon it with some degree of exactness, although he does not always distinguish clearly between things proved and things probable. He describes the disease which we now call "yellows," and leaves no doubt whatever that he has in mind the same disease mentioned by earlier and less explicit writers, such as Coxe and Peters. For these reasons, and because the book is seldom found, even in public libraries, I have here transcribed all that relates to yellows:¹

There are two causes that have operated against the success of this tree [the peach], and which seem peculiar to it—the one is a worm which attacks the tree at the root, near the surface of the ground, and often totally encircles it; the other is a disease usually denominated the yellows. [Here follows an account of the borer.]

Yellows.—This disease which commenced its ravages in New Jersey and Pennsylvania about the year 1797, and in New York in 1801, and has spread through several of the States, is by far more destructive to peach trees than the worm, and is evidently contagious. This disease is spread at the time when the trees are in bloom, and is disseminated by the pollen or farina blowing from the flowers of the diseased trees, and impregnating the flowers of those which are healthy and which is quickly circulated by the sap through the branches, and fruit, causing the fruit, wherever the infection extends, to ripen prematurely. That this disease is entirely distinct from the worm is sufficiently proved by the circumstance that peach trees which have been inoculated on plum or almond stocks, though less affected by the worm, are equally subject to the yellows—and a decisive proof of its being contagious is that a healthy tree, inoculated from a branch of a diseased one, instead of restoring the graft to vigor and health, immediately becomes itself infected with the disease. As all efforts totally to subdue it must require a long course of time, the best method to pursue towards its eventual eradication is to stop its progress and prevent its further extension—to accomplish which the following means are recommended, which have been found particularly successful.

As soon as a tree is discovered to possess the characteristics of the disease, which is generally known by the leaves putting on a sickly, yellow appearance—but of which the premature ripening of the fruit is decisive proof—it should be marked, so as to be removed the ensuing autumn, which must be done without fail, for if left again to bloom, it would impart the disease to many others in its vicinity: care is also necessary in its removal to take out all the roots of the diseased tree, especially if another is to be planted in the same place, so that the roots of the tree planted may not come in contact with any of those of the one which was diseased.

If your neighbor has trees infected with the yellows in a quarter contiguous to yours, it will be necessary to prevail on him to remove them, that yours may not be injured by them. By being thus particular in speedily removing such trees as may be infected, the disease is prevented from extending itself to the rest of the orchard, and the residue will constantly be preserved in perfect health at the trifling loss of a few trees annually from a large orchard.

"A distant subscriber," writing to *The New York Farmer* in 1831 (p. 154), also mentions premature fruit. He says:

Notwithstanding the wide destruction that the yellows has made, very few even at this day appear to understand the unerring symptoms of the disease. Let me say when the fruit ripens prematurely, from two to four weeks before the ordinary time, and the pulp is marked by purple discolorations, then beware!

¹ *A Short Treatise on Horticulture*, by William Prince. Printed by T. and J. Swords, 127 Broadway, N. Y., 1828, pp. 14, 15.

EXTENSION OF YELLOWS SINCE 1830.

The disease extended somewhat slowly, and its general movement appears worthy of special consideration, particularly as this may throw some light upon the nature of the disease. It may be noted, however, that it continued to prevail in the country about Philadelphia, where it was originally discovered, as shown by the following citations:

In 1838, in *The Farmer's Cabinet*, it is styled "that most insidious and fatal disease of the peach tree, the yellows."¹

In 1839, the same journal² prints the following from the pen of a correspondent:

The worm (*Egeria*) and the yellows are two great contemporary evils, which probably have no necessary connection with each other. The worm does not inquire whether the devoted tree is sick or in health; the yellows is not always followed by its ravages. Let us therefore persevere in our investigation of these maladies, so distressing to the lover of good fruit.

In 1847, the following appeared in *The Farmer and Mechanic*:³

For many years the peach tree has been subject to a disease known as the yellows. This disease seldom makes its appearance before the tree has arrived at maturity, as its great vigor and rapid growth appear to preclude the development of the disease previous to the tree fruiting. Much time, and labor, and research have been spent in fruitless endeavors to eradicate the disease after it has made its appearance in orchards, and the only result arrived at is the necessity for replanting new trees to take the place of the old ones at short intervals of time. Many applications to trees have been recommended, and potash, lime, tobacco, banking up trees in winter, etc., have had their advocates.

Although individual cures may have been effected, or decay for a time have been arrested by the remedies, yet such instances are extremely rare; and when applied on a large scale are shown to be without value. The disease, a true consumption, still continues and will continue, unless some radical method is adopted to eradicate it. From my own observation and experience, I am led to the belief that this formidable disease has been much aggravated and spread throughout the country by budding from trees containing in themselves the seeds of incipient consumption, not yet externally developed. A bud may be taken from a tree apparently sound, but after a time both trees will be affected and decay. * * * That the disease, however it may have originated, has not its origin in either the soil or climate of this latitude is pretty evident. Natural trees can now be found in great numbers of many years' growth, alongside fences and other neglected situations, perfectly sound and likely to remain so.

In 1878 yellows was still quite prevalent near Philadelphia.⁴

I. NORTHWARD AND NORTHEASTWARD MOVEMENT.—In New Jersey, peach trees continued to decay and peaches became scarce from some other cause than the attack of borers.⁵

¹ *The Farmers' Cabinet*, Philadelphia 1838, p. 297.

² Page 80.

³ Quoted in *The Farmers' Cabinet*, Philadelphia, Pa., January, 1848, pp. 182, 183.

⁴ *Rutter on the Peach*, Harrisburg, 1880, pp. 10 and 70.

⁵ *Niles's Weekly Register*, Baltimore, Md., June 15, 1816.

Dr. Sylvester¹ remembers that yellows was not one-tenth as prevalent in New Jersey in 1836 "as now [1861]"; but another writer² says:

Some of the fine peach districts of Jersey seem of late years [prior to 1838] to have lost their power of producing and continuing long-lived the tree that produces this * * * best of all fruits. We should like to hear from some of our Jersey subscribers if they can give us the reason why it is so, and if any clew has yet been found into that most insidious and fatal disease of the peach tree, the yellows.

At this time the peach was extensively planted throughout New Jersey;³ and prior to 1846 there must have been another great irruption of the disease, similar to that which took place between 1806 and 1814. In a very interesting communication,⁴ W. R. Prince, of Flushing, Long Island, declares that an "almost universal extermination" of the peach orchards took place in several States, and that "any one who will visit the once splendid peach orchards in various parts of New Jersey will be struck [1846] by the desolate aspect of innumerable plantations of dead trees, with only here and there a sprig of verdure." The disease was so prevalent that we begin to find complaint of its importation into other States.⁵

Col. Edward Wilkins, who was for many years an extensive and successful Maryland grower, is authority for the statement that "fifty thousand acres planted in peach trees, in two counties only of that State [New Jersey], had been destroyed by the yellows prior to 1850." In 1858 he visited New Jersey for the purpose of becoming better acquainted with the disease, and in the paper from which I have already quoted⁶ adds that "at that time nearly the whole of the peach orchards of New Jersey had been destroyed by a disease known as the yellows."

Prior to 1854 it was found necessary, we are told, to renew the peach orchards of New Jersey and [upper] Delaware every five or six years.⁷ In fact, as early as 1839, I find the following statement:⁸

Peaches are a profitable article of culture in the country through which we have traveled. * * * The profits would be far greater if means could be adopted to prevent the early decay of the trees. The average continuance of a peach orchard is from six to eight years; and four crops of fruit are considered a liberal return. The disease which destroys the trees is termed the yellows. Would it not be commendable in the New Jersey State Agricultural Society, which has just been organized, or even in the legislature of that State, to offer a bounty for the discovery of a cure or preventive of this disease? * * * The extent of the peach plantations will seem extravagant to some of our northern readers. Many growers have 10,000 trees; one,

¹ Discussion before the Fruit Growers' Society of Western New York. *Genesee Farmer*, Rochester, N. Y., March, 1861, p. 89.

² *Farmers' Register*, Petersburgh, Va., August, 1838, p. 261. Quoted from *Farmers' Cabinet*.

³ T. Hancock, Burlington, N. J., January, 1841. *Hovey's Magazine of Horticulture*, Boston, 1841, p. 90.

⁴ *The Horticulturist*, Albany, N. Y., 1846, pp. 318, 319.

⁵ *Ibid.*, p. 237.

⁶ *The American Farmer*, Baltimore, Md., 1875, pp. 100-102.

⁷ *The Plough, Loom, and Anvil*, New York, 1854-'55, vol. 7, p. 359.

⁸ Notes on New Jersey Farming. *The Cultivator*, Albany, N. Y., September, 1839, p. 131.

30,000; and at one place in Shrewsbury [Monmouth County], there are 50,000 trees growing contiguous and forming as it were one magnificent orchard.

Four years previous to this Niles's Register contained the following note:¹

A gentleman in Shrewsbury, N. J., will, it is said, realize by his peach crop this year from \$10,000 to \$12,000. We should have thought that every peach tree had been destroyed, if we could have believed the croakers, some time ago.

In 1861 William Reid, of New Jersey, writes:²

Eight or ten years is as long as we can get peach trees to live here. They invariably die with yellows.

In 1878 an old Monmouth County peach-grower, then resident in Michigan, is quoted³ as saying that yellows made its appearance in Monmouth County, N. J., about 1850, "and culminated in the destruction of the peach orchards about 1856." The report continues:

Monmouth County and vicinity were famous in their day, having often glutted the Eastern markets with peaches. Driven from the Atlantic coast counties by the yellows, the prominent peach-growers of New Jersey located in Morris and other counties in the north of the State, where peaches were grown successfully until about 1867, when New Jersey peach-growers were again driven by the yellows to fresh fields.

This man is said to have been an eye witness to both outbreaks. The disease probably appeared in Monmouth County earlier than 1850.

"Generally, after bearing their second crop," says Mr. Barry, in 1861,⁴ "the New Jersey orchards all die; still, in some parts even of New Jersey, they are exempt from the disease [yellows]." Mr. Sharp warns the peach-growers of western New York that "many New Jersey trees are being sold here," and is "fearful lest we become like New Jersey."⁵ Later, as a matter of fact, this proved to be the case.

The Transactions of the West Jersey Fruit-Growers' Association, 1864, edited, apparently, by William Parry, a noted fruit-grower, says that—

Twenty-five or thirty years ago peaches were grown in this locality [east and northeast of Philadelphia, near the Delaware River] with but little care or cost; but a change came over them, and for many years scarcely any could be produced. Many trees that were planted out died without producing any fruit; indeed, it was thought to be an entire waste of labor to plant peach trees. But there seems reason to believe that they are again becoming a surer crop, and many are planting out new orchards.

The first crop of peaches at Vineland, N. J., was in 1868, the growth of the trees being all that could be desired.⁶ Yellows appeared in the

¹ *The Register*, Baltimore, Md., 1835, p. 70.

² *The Horticulturist*, 1861, p. 129.

³ *Annual Report of the Michigan State Pomological Society*, Lansing, 1878, p. 256.

⁴ Discussion before the Fruit-Growers' Society of Western New York. *Genesee Farmer*, 1861, p. 89.

⁵ *Ibid.*

⁶ Vineland correspondent of *The Cultivator and Country Gentleman*, Albany, N. Y., 1868, p. 291.

village as early as the year 1876, but could not then be found in the surrounding orchards,¹ where it has since appeared.

In 1873 Alexander Pullen declared that—

The peach trees cultivated in orchards here [central Delaware] usually live from twenty to twenty-five years, and have been known to live forty or even fifty; while in New Jersey, where peaches are cultivated extensively for sale, orchards planted live only from seven to ten years.²

In 1875 Colonel Wilkins³ declared that "in New Jersey the peach belongs to the past."

In 1877 Thomas C. Haywood, of Flemington, Hunterdon County, N. J., says of peach trees:⁴

The duration of bearing is from five to seven years from commencement. This will vary from several causes, such as variety of soil, exposure, etc., some orchards bearing for ten years, some not giving more than three or four good crops.

In 1882 Professor Penhallow writes:⁵

In New Jersey, where the ravages of the disease have been more seriously felt than elsewhere, the southern counties were formerly the center of the peach industry for the entire State, but, owing to the prevalence of the yellows the peach orchards have been gradually moving northward, until at the present time the counties of Morris and Hunterdon have the largest interest involved, and the prospect is that a few more years will see even these localities deprived of the industry.

Again we read:⁶

The peach growers of New Jersey consider an orchard worth nothing after the age of nine years. At that time they root out all the trees as they would so many corn stumps, and use the land for general crops, planting a young orchard of seedlings each year to make good the loss.

In 1887 W. F. Stavely, of Still Pond, Md., visited Hunterdon County, and was told by growers at Cedar Hill that it was their custom to plant peach orchards every year, removing those already planted when five or six years old. Yellows is very destructive, and growers consider themselves fortunate if they secure two crops from an orchard.⁷ This county produces many peaches. In 1887, John W. Cox, commission merchant, bought 90 car-loads for the Philadelphia trade, and thinks he did not secure over 10 per cent. of the entire crop.⁸ In fact, the principal orchards of New Jersey are now located there.

The condition of peach growing in New Jersey in 1887 is partially

¹ A. J. Pearson. *Proceedings of the New Jersey State Horticultural Society*, 1886, p. 182. Newark, N. J., 1887.

² Report on Peaches, by chairman of the committee, to the Central Delaware Fruit-Growers' Association, January, 1873. *The Maryland Farmer*, 1873, p. 77.

³ *Loco cit.*

⁴ *Report of New Jersey State Board of Agriculture*, 1877, p. 129.

⁵ Peach Yellows. By D. P. Penhallow, B. S. *Houghton Farm Experiment Department. Diseases of Plants*, 1882. Series III, No. 2, p. 27.

⁶ *Ibid.*, p. 28; and *Houghton Farm Experiment Department. Diseases of Plants*, 1883, p. 60. See also a paper by Professor Penhallow on "Diseases of Plants," *Popular Science Monthly*, New York, 1884, p. 386.

⁷ Conversation at Still Pond, August 5, 1888.

⁸ Conversation at Chestertown, Md., August 1, 1888.

set forth by the statistician of the United States Department of Agriculture in a paper upon "Peach Yellows."¹ This paper is a digest of reports by correspondents, and deals especially with the distribution of the disease. New Jersey contains twenty-one counties. Reports were received from fifteen counties, in nearly all of which the yellows is said to be present. The digest by counties appears to be sufficiently interesting to be reproduced in full:

Atlantic: Peach yellows have done much damage here in years past. *Bergen*: Very common; few trees are grown on that account. *Burlington*: Few orchards without its appearance; and as the crop is one of the most profitable, where it can be had of fine quality, the discussion of the topic "peach yellows" attracts much interest in our State and local horticultural societies. *Camden*: Very few peach orchards in this county, owing to the prevalence of the yellows. * * * *Cape May*: In some localities quite common. *Essex*: Peach growing died out of this county many years ago, and it is impossible to get much information on this subject. *Gloucester*: Not as common as formerly. *Hunterdon*: It is common. *Mercer*: In this locality there are some diseased peach trees; whether it is the yellows or not, it is hard to tell, for if these very trees which show disease are properly treated with certain chemicals they will put on a green appearance and bear fruit. *Middlesex*: No such disease reported in this county. *Morris*: It is common. *Salem*: It is common. *Somerset*: It is very common and general. *Union*: It is common. *Warren*: It is very common, and the only remedy is to terminate the existence of the trees.

The disease has been reported to me from two additional counties, Monmouth and Cumberland, and I have the statement from another grower that yellows is common in Middlesex County. Concerning southern New Jersey, the following statements from growers will be of interest.

In answer to inquiries concerning the existence of yellows in the vicinity of Roadstown, J. McSmalley replies:²

We have, I am sorry to say, what you are inquiring after. It is becoming general throughout southern New Jersey. I have two orchards—one set four, the other five years; one on land highly improved, the other on poor land. I see but little difference in disease. We have never been troubled much until within five or six years, but it is on the increase, attacking younger trees that are making good growth, and filling them with what we call water-sprouts on the trunk and large limbs. Do not know of any remedy.

To similar inquiries respecting South Vineland John C. Wheeler replies:³

Peach yellows, having all the characteristics you describe, is present in my orchards and exists to quite an extent in this part of the country. It appeared in my orchard four years ago.

I have dug out about 6 per cent. of the trees as useless and about 1 per cent. that showed premature fruit, though otherwise apparently healthy, for fear they would injure healthy trees.

Concerning Greenwich, near Delaware River, Charles Miller writes:⁴

¹ Report on Condition of Growing Crops, etc., August, 1887, U. S. Department of Agriculture, Washington, D. C., pp. 372-380.

² Letter of January 30, 1888.

³ Letter of January 27, 1888.

⁴ Letter of February 4, 1888.

The peach yellows are in all the orchards of this vicinity. The fruit on a diseased tree will premature and rot; and a starved growth of shoots will appear on the branches or body of the tree.

It has not been of much injury to us until the last five or six years. Our orchards now will premature one-tenth or more the first year of bearing. It will begin to show in an orchard the second year even before it begins to fruit. In some localities they do better than I have stated and in others not so well.

It is apparent that the ups and downs of peach-growing in New Jersey have been many. In spite of all reverses growers have continued to plant peach trees. In many instances yellows has swept these away before fruiting age, while in others they have lived long enough to return a handsome profit. Many growers consider the peach profitable in spite of yellows, and plant expecting to lose their orchards after two or three crops.

Eastern New York.—According to A. J. Downing (*l. c.*) the yellows reached southern New York prior to 1814. According to William Prince¹ it was present as early as 1801.

In 1826 a writer in the New York Evening Post says,² “The cause of the decay in our peach trees is the borer,” but furnishes no satisfactory proof.

In 1833 Michael Floy edited an edition of Lindley’s “Guide,”³ having had thirty years’ experience as a nurseryman in New York. In treating of peaches and nectarines he discarded Lindley entirely and wrote a chapter of his own, from which I quote:

About twenty or twenty-five years ago peaches were raised here in the greatest abundance, and with only a moderate share of attention in great perfection. That this time, however, has gone, etc. (p. 363).

Aside from a possible change in climate he assigns four reasons for this decay. First, budding on peach stocks; second, the borer; third, a too rapid growth, forming a straggling tree likely to be broken down by high winds; and fourth, the yellows. Of the latter he says,

The trees of late years are subject to what has been deemed a disease, called the yellows from the circumstance that the trees have a yellow, sickly appearance. * * *

In 1832, after a severe winter, some of his own trees—

Ripened their fruit prematurely, without having anything of the true flavor; and, what is remarkable, every diseased tree, of whatever kind, seemed to bear the same red and red-speckled, tasteless, and insipid peach, some of them coming to maturity a month too soon.

He says all these “were perfectly sound and healthy the summer previous,” and thinks the yellows was caused by the severe winter, which injured the trees without killing them. He says that in every instance he found the pith of such trees was black or black spotted (p. 365).

¹ *Treatise on Horticulture, N. Y.*, 1828.

² Quoted in *American Journal of Science and Arts*, 1st series, Vol. XI, 1826.

³ *A Guide to the Orchard and Fruit Garden, etc.*, by George Lindley. Edited by John Lindley. First American from the last London edition, by Michael Floy, gardener and nurseryman and corresponding member of the Horticultural Society of London. New York, 1833. The second edition of this book was published about 1845.

Somewhat later Downing¹ declares that—

Fifteen years ago [1834] there was scarcely a tree in the vicinity of Newburgh [on the lower Hudson] that was not more or less diseased with the yellows. By pursuing the course we have indicated [digging and burning], the disease has almost wholly disappeared.

In 1841² *The Cultivator* distinguishes between the effects of the borer and the yellows, and says of the latter:

Within a few years a disease called the yellows has destroyed many of the best trees or orchards in the Northern or Middle States.

In the same volume, D. Tomlinson, of Schenectady, N. Y., tells how to destroy the borer, and adds:

The yellows is complained of at Poughkeepsie, N. Y., and in New England. It has not appeared here.

In 1846, in the paper from which I have already quoted, W. R. Prince, of Flushing, Long Island, says:

In this island the malady became exhausted some years since by the utter destruction of the old orchards, and the determination not to plant new ones until it became extinct. This proved most fortunate as the disease has been for years banished from Long Island, and now new orchards are springing up everywhere * * * "redolent with health."

In 1852 the yellows is mentioned as that disease "which for thirty years has killed off the trees by thousands."³

In 1878 Charles Downing writes from Newburgh, on the Hudson:⁴

We have had the yellows here at intervals for over sixty years, sometimes continuing for five or six years and then several years free from it.

In 1883 yellows was quite prevalent along the west side of the Hudson, in Orange and Ulster Counties, N. Y.⁵

In 1887, Col. F. D. Curtis, of Saratoga County, N. Y., is quoted⁶ to the effect that yellows is not common in eastern New York, but it has been reported a number of times since 1880 from southeastern New York,⁷ and I have been informed that it was quite destructive in some orchards on the lower Hudson, in the year 1887.

Connecticut.—Although yellows reached Connecticut as early as 1814 or 1815,⁸ it does not appear to have immediately discouraged peach-growing, for P. M. Augur,⁹ the State pomologist, declares that—

In the first quarter of this century the peach was raised in Connecticut with success. The fruit was common and abundant. Since then it has been a rare fruit.

¹ A. J. Downing, *The Horticulturist*, Albany, N. Y., 1849, p. 503.

² Albany, N. Y., 1841, p. 95 and p. 131.

³ *The Plough, Loom, and Avril*, New York and Philadelphia, 1852, Vol. V., Part I, p. 347.

⁴ *The Canadian Horticulturist*, 1878, p. 173.

⁵ *Peach Yellows, Penhallow. H. F. Exp. Dep't Diseases of Plants*, 1883. Appendix to Series III, No. 2, pp. 56, 57, and 58.

⁶ *Condition of Growing Crops, August, 1887*, U. S. Department of Agriculture, p. 374.

⁷ *The Country Gentleman*, 1884(?); *Report of Connecticut Board of Agriculture*, 1884, p. 25.

⁸ A. J. Downing, *Fruits and Fruit Trees of America*; and Noyes Darling, *The Cultivator*, Albany, N. Y., 1845, p. 60.

⁹ *Report of the Connecticut Board of Agriculture*, 1872, p. 332, and 1883, p. 14.

C. Butler, of Plymouth, writing on yellows says :¹

I came into this country early in 1801 and have resided here ever since. When I first came here peaches were very plenty. They were not raised for market, but for the family to eat, preserve, and give to the neighbors and friends, and were almost as sure a crop as potatoes. This continued to be the case until 1810. In December, 1809, there was a very extensive and severe cold freezing turn, which killed nearly all the peaches in this vicinity and as far west as to Lake Erie. Since then, for some cause unknown to me, it has been much more difficult to grow peaches in this part of the country, but no more difficult on plowed land than on sward.

Mr. Butler says he has had experience with yellows. He believes it is contagious, but has no proof beyond the common observation that "when one tree was infected other trees standing near would be, unless the infected tree was immediately removed, in which case the healthy trees would generally be preserved."

In the vicinity of New Haven yellows appeared as early as 1820 and destroyed thousands of trees and nearly put an end to peach-growing between the years 1830 and 1846.²

According to John F. Fitts, of East Windsor, peaches were plenty fifty years ago [1827]. The soil is suited to them and they grow well, but die soon.³

From West Chester, in 1840, David Foote writes as follows:⁴

I have a number of trees of the yellow kind, which ripens usually about the 1st of October, but last season [1839] they bore fruit resembling the red rare ripe, and ripened about a month earlier than ever before. Now the question is, what was the cause of this change of color and time of ripening? I can not tell unless it is caused by some disease which may cause the premature death of the trees.

In 1849 a committee for the State of Connecticut reported to the Second Congress of Fruit Growers on peaches as follows:⁵

People in this region have become very much discouraged in regard to raising this delicious fruit. The trees have the yellows in many cases before they begin to bear, and if they bear at all, it is only for one or two seasons; seedlings or some inferior sorts may be an exception [?]. The choice standard varieties, if they bear so much as one season, do not last. One of your committee, ten years ago, raised as fine peaches as could be desired and in great abundance, but now, on the same ground, with much pains, is unable to get any worth naming.

A. J. Downing, chairman of the general fruit committee, edited the proceedings, and comments on the above report as follows:

The explanation of the great prevalence of yellows in Connecticut lies, we imagine, in the fact of the large introduction of later years of unhealthy trees, bought indiscriminately in the markets of New York. A little attention to destroying every tree

¹ *The Cultivator*, N. Y., 1813, p. 182.

² Noyes Darling: *The New York Farmer and Horticultural Repository*, New York, 1831, p. 9; and *The Cultivator*, Albany, N. Y., 1845, p. 60, and 1846, p. 141.

³ *Report of Connecticut State Board of Agriculture*, 1877, p. 340.

⁴ *The Cultivator*, Albany, N. Y., 1840, p. 95.

⁵ Report of George Gabriel, A. S. Munson, V. M. Dow, H. Terry, and W. W. Turner. Proceedings of the Second Congress of Fruit Growers, convened under the auspices of the American Institute, New York City, October, 1849. *Trans. of the Am. Inst.*, 1849. (8th An. Report). Albany, N. Y., 1850. Assembly No. 199, p. 275.

already affected and in introducing those of healthy constitution from other districts will very soon result in the production of the finest fruit again, as has been abundantly proved in many parts of the State of New York.

In 1852, John L. Yoemans, of Columbia, Conn., writes¹: "The yellows are destroying our peach trees." He knows no remedy but to dig out.

In 1855, Gurdon W. Russel, of Hartford, writes²:

The disease called yellows is very destructive and has destroyed thousand of trees throughout the county and will destroy thousands more, until cultivators will procure their trees from healthy localities and will be willing to bestow some care and attention on them when planted and fruiting. The disease is eminently contagious and is capable of being propagated, we believe, from blossom to blossom by insects, and as yet we have found no effectual remedy.

In 1866 William H. White, of South Windsor, writes that peaches are infested with yellows, and are generally "things of the past."³ The same year William C. Yoemans, of Columbia, writes of the peach:⁴

Its cultivation is now nearly abandoned, and has been for a few years, in consequence of that scourge to that fruit known as yellows.

In 1875 P. M. Augur⁵ notes incidentally, "the prevalence of yellows in Connecticut."

Under date of May 25, 1887, in a communication to the Department, Henry J. Nettleton, of Durham, Conn., says that his peach trees have been troubled by yellows and are short-lived, especially if they make a rapid and thrifty growth.

Massachusetts.—This State is less adapted to peach-growing than Connecticut, and references to yellows are fewer.

In 1833, The Orchardist, of Boston, declares that the disease is not known in New England.⁶

John B. Moore, a prominent member of the Massachusetts State Horticultural Society, declared in 1882 that yellows was unknown in the vicinity of Boston forty-five years ago—*i. e.*, in 1837—but says that "when it came, it swept everything."⁷

Samuel Hartwell, of Lincoln, in a communication on peach yellows to Professor Penhallow,⁸ says that:

Thirty or forty years ago [1842-1852] peaches were grown in great abundance and perfection in this vicinity [Northeast Massachusetts], but for the last twenty years [since 1862] have been almost abandoned.

¹ Report of the Commissioner of Patents (Agriculture). Washington, D. C., 1852, p. 166.

² Transactions Connecticut State Board of Agriculture, Hartford, Conn., 1855, p. 138.

³ Report of Connecticut Board of Agriculture, 1866, Hartford, 1867, p. 169.

⁴ Ibid., p. 173.

⁵ Report of the Connecticut Board of Agriculture, 1875, p. 248.

⁶ Michigan Pomological Report 1873, p. 21.

⁷ Trans. Mass. State Hort. Society, 1882, Part I, p. 140.

⁸ Peach Yellows. Penhallow. H. F. Exp. Dep't Diseases of Plants, 1852. Series III, No. 2, p. 27.

In 1848, William Kenrick writes of yellows:¹

But there is another malady, which I believe is unknown in New England, or at east I have never seen or heard of such a disease with us.

The earliest clear account of the occurrence of this disease in Massachusetts, which I have found, is that given by T. W. Harris, the entomologist, who saw yellows in his garden in 1854. He says:²

For the first time in eleven years the symptoms of this disease have appeared in my garden. It is confined to two branches on the north side of one peach tree, the fruit of which is becoming red some three or four weeks too soon, while a few wiry shoots, clothed with diminutive and pale leaves, have sprouted upon the branches. Neither borers nor the *Tomicus luminarius* have been discovered in the tree; and the cause of the disease remains as much a mystery to me as to other cultivators. * * * In former years peach trees have rarely suffered from yellows in this neighborhood [Cambridge, Mass.], where now many trees are affected by it.

In 1878, yellows was present at Amherst, in western Massachusetts.³

The foregoing embraces so much as I have been able to learn about the northern and northeastern movement of yellows.

Summary.—So far as its present distribution is concerned we may infer that the disease occurs, or is likely to occur, anywhere from the Delaware River north and northeast, through New Jersey, eastern New York, Connecticut, Rhode Island, and Massachusetts, to the extreme limits of peach-growing in the more northern New England States.

It would seem also that the disease did not appear on the northern limits of peach-growing until many years after it had destroyed orchards in more favorable southern locations.

2. WESTWARD AND NORTH-WESTWARD MOVEMENT.—In the following pages is given the substance of what I have been able to learn concerning the appearance of yellows in central and western Pennsylvania, in western New York, Ontario, Ohio, Indiana, and Michigan.

Pennsylvania.—In 1851, William G. Warren, of Centre County, Pa., writes:⁴

A majority of the peach trees in the country have been destroyed by the yellows.
* * * Trees affected by the yellows ripen their fruit prematurely.

In 1852, at the Philadelphia meeting of the American Pomological Society, the committee on peaches presented reports from fruit growers in different States, one of which, by a Pennsylvanian, stated that "peaches have done but ill with us for some years past. The yellows have swept off thousands of trees."⁵

¹ *The New American Orchardist*, by William Kenrick, Boston, 1848. Eighth edition, p. 203.

² Remarks on some of the diseases and insects affecting fruit trees and vines. *Proc. Am. Pomological Society*, Boston meeting, 1854, p. 212. Printed also in *The American Farmer*, Baltimore, Md., 1855, pp. 231-35.

³ *Trans. Mass. Hort. Society*, 1882, Part I, p. 120.

⁴ *Report of the Commissioner of Patents (Agriculture)*. Washington, D. C., 1851, p. 242.

⁵ *The Plough, Loom, and Anvil*, New York and Philadelphia, 1852, Vol. V, Part II, p. 38.

In 1867, and for years previous to that date, peach yellows was very prevalent and destructive in the counties of York, Cumberland, and Dauphin, *i. e.*, in the vicinity of Harrisburg. I have this statement on the authority of J. W. Kerr, president of the Peninsula Horticultural Society, now of Denton, Md., but then resident in Pennsylvania, and personally acquainted with the disease.¹

In 1875 "Casper Hiller said that the yellows was less prevalent [in Pennsylvania] than formerly."²

In 1887 I received samples of diseased trees from McAlisterville, Juniata County, Pa., with the statement that the disease was in young orchards, and was doing much injury. The peaches ripened prematurely and the trees most diseased put out the usual wiry growth.

The same year, William G. Smith, of Pittsburgh, Pa., reports a general freedom from yellows,³ and Henry L. Rupp, of Cumberland County, says: "Yellows is not a common disease, but is sometimes brought from infected nurseries, not appearing in healthy orchards planted with trees not infected."⁴ Mr. Rupp adds that in another county of Pennsylvania on poorer soil the yellows sweeps away whole orchards.

I have myself seen the disease in a number of places along the line of the Pennsylvania Central Railroad, particularly in the summer of 1888, near Pittsburgh, near Johnstown, and near Harrisburg.

Ohio.—Yellows was reported from Ohio as early as 1849. Between that date and 1851, an orchard of 600 trees belonging to A. W. F. Genin, of Saint Clairsville, is said to have been nearly all destroyed by it.⁵ Another Ohio man, living in Richland County, says: "Our peach trees are somewhat affected with yellows."⁶ No symptoms are mentioned by either writer, and the injury may have been due to something else.

In 1879 the secretary of the State Horticultural Society writes as follows about yellows:⁷

The disease, which has hardly been known in Ohio except by name, has caused much trouble and apprehension among the peach growers of the lake shore district of Michigan for a year or two past. It has ruined quite a large number of orchards and seems to be still spreading, in spite of the efforts to arrest it by cutting down and burning all affected trees as is done by compulsory law. It appears, too, from recent accounts, that the disease made its appearance the past season and is spreading rapidly this summer [July, 1879] in the lake shore peach orchards of Niagara

¹ Letter of April 16, 1858. See, also, statement in *Proceedings of Peninsula Horticultural Society*, Dover, Del., 1888, p. 47.

² Report of Pennsylvania Fruit Growers' Association. *The Cultivator and Country Gentleman*, Albany, N. Y., 1876, p. 310.

³ *Condition of Growing Crops, August, 1887*, Department of Agriculture, Washington, D. C., p. 374.

⁴ *Ibid.*

⁵ *Report of the Commissioner of Patents (Agriculture)*, Washington, D. C., 1851, p. 369.

⁶ *Ibid.*, p. 378.

⁷ *Twelfth Annual Report of the Ohio State Horticultural Society*, Columbus, 1879, p. 106.

County, N. Y., so that there is reason to fear that the lake shore region of Ohio will have a visitation of the malady.

I have examined these Ohio reports from 1870 to 1887, but find nothing more on yellows, except some denials of its presence from different parts of the State.

In 1887, however, I have reason to believe that the disease was present in widely different parts of Ohio. Under date of September 10, 1887, Prof. W. R. Lazenby, of Columbus, writes:

Our State fair was held here last week and the exhibit of peaches was one of the finest that I have ever seen in Ohio. In conversation with many of the growers from the northern part of the State, I find that the yellows is wide-spread and many trees are being destroyed each year.

Under date of September 12, 1887, H. G. Tryon, of Willoughby, Lake County, writes of yellows:

We have a full supply of diseased fruit, * * * though we aim to take out every diseased tree as soon as practicable after discovering it. I always have trees that need destroying, and suppose this will continue to be the case as long as I have peach trees left. * * * We have had the disease among our trees since 1879.

Western New York.—I am not able to determine how early peaches began to be cultivated in western New York. In Ontario County they were certainly grown by the whites considerably prior to 1821,¹ and were undoubtedly cultivated by the Indians at a much earlier date. Mr. J. J. Thomas thinks seedling trees were cultivated by the white settlers as early as 1800. These were rare-ripes, and Indian or blood peaches. He thinks the first budded trees were set about 1815 or 1820. His father set many New Jersey trees in 1821.²

It was soon discovered that certain localities in western New York were quite well adapted to peach growing, and in these, if we may believe concurrent testimony, the peach was grown for many years entirely free from yellows. Precisely how early the disease appeared is uncertain, but 1824, the earliest date assigned, is probably not far from the actual time of its appearance in the eastern portion of this district.

In 1831 David Thomas, a celebrated fruit-grower of Cayuga County, writes:³

Previous to the year 1824 I had never seen a peach tree with the yellows in this part of the State of New York. The ancient trees standing in the old Indian clearings had escaped untouched by this malady, and the *Egeria eritiosa* had only diminished their vigor by mechanical injuries.

In that year the writer planted some trees from one of the Flushing nurseries, which made a feeble growth and finally died. Being rare and high priced sorts, he was very desirous of continuing the varieties, and therefore budded into a most thrifty stock in his nursery, and also inserted some buds into thrifty trees in his orchard.

¹ *The Michigan Farmer.* Niles, Mich., 1849, p. 169. The writer remembers but one failure of the peach crop previous to 1821.

² Letter of November 1, 1888.

³ *The New York Farmer and Horticultural Repository*, New York, 1831, p. 46.

On the young stock two buds took but never sprouted; and in less than a year that stock dwindled like the tree whence the buds were taken and died. Every tree in my peach orchard so budded has been long since dead; and no other peach tree has died in that orchard.

From other statements in this article there is some doubt whether this was really yellows, but Mr. J. J. Thomas says it was. At all events the disease did not then have any foothold in that vicinity.

In 1838 or 1839, "J. J. T." in *The Genesee Farmer*,¹ speaks of "the easy culture and rareness of disease in the peach tree in western New York."

A year or two later in *The New Genesee Farmer* a writer upon yellows says:²

In western New York more than thirty years passed away after the Indian had resigned his old peach orchard to the white man before it was introduced amongst us.

In 1844, J. J. Thomas writes of yellows:³

In western New York it is comparatively unknown, and great care should be used by cultivators that it be not introduced by importation.

In 1846, it is stated⁴ that yellows has occasionally been imported into western New York from New Jersey. The disease does not, however, appear to have become well established until after this date.⁵

The same year Patrick Barry, of Rochester, declares that—

The peach is an important fruit in our region. Our soil and climate are highly favorable for its culture. * * * The peach worm is the chief difficulty we have to oppose, and that is not a serious one.⁶

He also says that—

There is no part of the United States where the peach is more healthy or attains a greater age than in western New York. It is improper soil or culture and bad treatment that has caused early decay where it has occurred.⁷

In 1852 a New York fruit-grower, speaking for Rochester, declares:⁸

It is notorious that the yellows mentioned was first introduced there in trees imported from New Jersey.

In 1861, yellows was quite at home in some parts of western New York, but, as we have already seen, New Jersey peach trees continued to be planted freely.⁹

¹ Quoted in *The Farmers' Register*, Pittsburgh, Va., 1839, p. 261.

² *Ibid.*, November, 1840, p. 665.

³ *The Cultivator*, Albany, N. Y., 1844, p. 255.

⁴ *The Horticulturist*, Albany, N. Y., 1846, p. 237.

⁵ *Ibid.*, 1846, p. 237, and 1848, p. 34.

⁶ *The Genesee Farmer*, Rochester, N. Y., 1846, p. 94.

⁷ *Ibid.*, p. 242.

⁸ Report at Philadelphia meeting, September, 1852, of a committee of Am. Pom. Soc. *The Plough, Loom, and Anvil*, New York and Philadelphia, Vol. V, Part II, p. 38.

⁹ Fruit-Grower's Society of West New York. Report in *The Genesee Farmer*, Rochester, March, 1861, p. 89.

In 1874, in *The Cultivator and Country Gentleman*,¹ I find the following interesting account of peach growing in Niagara County:

The growing of the peach for market is fast becoming a very important branch of industry in this county. This is probably one of the most favorable portions of the country for growing this fruit successfully. With ordinary care and culture the peach here grows to perfection. Until within a very few years past, comparatively few have been engaged in this business. Those few have made money. But the rest of the farmers are beginning to find out that raising peaches pays, and the rate at which orchards have been and are being set out is wonderful. I think that fully one-half of the peach orchards in this county have been set within the last three years. Those who a few years since thought four or five trees a plenty are now setting at the rate of 1,000 to 2,000 trees in a single spring. Peaches are nearly a sure crop here every year. The crop of the past season [1874] was unusually large. * * * As nearly as can be ascertained there were fully 100,000 crates [three-fourths bushel each] shipped from this county. * * * The average price received by farmers was about \$1 per crate.

In 1877 there were still further favorable reports from this region. A correspondent of *The Cultivator and Country Gentleman*² says of peach culture along Niagara River:

Most of the peach orchards in this region are in full vigor. They bore good crops for the past five years in succession. This year, from some unknown cause, there are very few. It is estimated that the peach orchards of the township of Niagara contain 40,000 trees, and it is likely to become noted as one of the best peach regions of the State. The best peach region appears to be confined to a breadth of a mile or two along the river. Farther inland this crop has not been so successful until we reach the neighborhood of Lockport.

We also meet statements like the following:³

Last summer, in reporting the success of peach culture in the Niagara River [region], near the falls, we mentioned the orchard of Mr. Burdett, which had borne fruit for more than twenty years, consisting of 2,000 trees, and yielding, in a favorable season, over \$6,000.

Judging from these accounts, yellows was not prevalent in Niagara County in 1874 or in 1877. Very different, as we shall see, are the reports from this region ten years later. The Ohio authority already quoted states that yellows first appeared in the Lake shore orchards of Niagara County in 1878 and spread very rapidly in 1879; but from statements by A. M. Smith⁴ it would appear reasonably certain that this disease was prevalent in several trees in at least one orchard in Niagara County as early as 1874 or 1875. He also says that hundreds of bushels of high colored, insipid, premature peaches were sold in western New York in 1877; that the Niagara orchard in which he first saw the disease was totally destroyed by it; and that several others in the vicinity had become badly affected.

¹ "B. G. P." *The Cultivator and Country Gentleman*, Albany, N. Y., 1874, p. 820.

² Quoted in *The Garden*, London, England, June, 1878, p. 474.

³ *The Cultivator and Country Gentleman*, Albany, N. Y., 1877, p. 554.

⁴ *The Canadian Horticulturist*, 1878, pp. 15, 16.

In 1880, Charles W. Garfield says:¹

Mr. J. S. Woodward, of Lockport, N. Y., put out 30 acres of peach trees a few years ago, and now he is taking them all out before having got a crop, all being diseased with yellows. He thinks they must stop raising peaches there.

In 1880, Hon. T. T. Lyon is also reported as follows:²

He had heard that Western New York was free from yellows, but last winter he had letters from Hamilton, Ontario, saying that peaches with yellows had been imported there from New York, and the disease was spreading. Last year [1879] he saw yellows near Rochester and saw that the commercial orchards there were being ruined by it. The claim that they do not have it there is false.

In 1885, judging from Dr. J. C. Arthur's description, the disease was present to a considerable extent in orchards in two localities not many miles from Geneva.³

In 1887, J. S. Woodward himself says⁴ yellows has "nearly finished the orchards." In his opinion it was first introduced in New Jersey trees. He does not think the disease is due to soil poverty.

Col. F. D. Curtis, of Saratoga County, also declares⁵ that yellows has destroyed whole orchards in the western counties of New York where peach growing is more prominent, especially in Niagara and Ontario. It has attacked healthy orchards in vigorous condition.

Ontario.—Does the disease occur in Canada? In the spring of 1878, A. M. Smith, a considerable fruit-grower of Drummondville, Ontario, published in *The Canadian Horticulturist* (p. 15) "A word of warning to peach-growers of Ontario," in which he says:

Perhaps it is not generally known, but it is nevertheless a fact, that the disease so destructive to peach orchards, called the yellows, has made its appearance in our midst. Quite a number of orchards on the frontier, particularly in the vicinity of Drummondville and Stamford, have had affected trees in them the last season, and some in the great peach-growing section of Grimsby. The symptoms of this disease are, first, an enfeebled vitality, the foliage looks sickly; and second, the fruit ripens prematurely, sometimes two or three weeks before its usual season for maturing, and is usually high colored, red and flecked or spotted, and is red around the stone. This occurring in young trees newly planted has led many to think they had some new variety which was very early; but the flavor is universally insipid and watery, and the fruit nearly worthless.

As before mentioned, Mr. Smith saw this disease in Niagara County, N. Y., as early as 1874 or 1875, and thinks there was some of it in Ontario at that time, which is very likely, considering its prevalence in 1877, 1878, 1879, and 1880.

In the autumn of 1878, Linus Woolverton, another prominent fruit-grower, confirmed Mr. Smith's statements, attributed the disease to

¹ *Annual Report Secretary Michigan State Horticultural Society, Lansing, Mich., 1880*, p. 275; see also *The C. and C. Gent.*, 1884, p. 28, where the orchard is said to contain 20 acres of good soil.

² *Annual Rep. of the Sec'y of the Mich. State Hort. Soc., 1880*, p. 274.

³ *Third Annual Report of the Board of Control of New York Agri. Experiment Station, 1884*, Albany, N. Y., 1885, p. 372.

⁴ *Condition of growing crops, August, 1887*, United States Department of Agriculture, Washington, D. C., p. 374.

⁵ *Ibid.*

trees imported from the States, and drew up the following resolution, which was adopted by the peach-growers of Grimsby:

Whereas we are made aware of the presence of yellows in one or two peach orchards about Grimsby: Therefore,

Resolved, That we do most strongly advise every grower to carefully watch the first indications of its approach, and at once uproot every tree affected by it; and further to use the utmost caution in the selection of trees for planting.¹

D. W. Beadle, nurseryman and fruit-grower, of St. Catherines, and formerly editor of *The Canadian Horticulturist*, writes that—

The peach yellows first appeared in Ontario about twelve years ago [*i. e.*, in 1876], almost simultaneously at Grimsby and Stamford, the first in the county of Lincoln and the second in Welland County. In Stamford it has destroyed many of the orchards entirely. In Grimsby up to the present time its ravages have not been so severe.²

By the year 1880, the disease appears to have become prevalent in nearly all parts of the Niagara district, *i. e.*, in the neck of land between Lake Erie and Lake Ontario. Aside from other evidence, the fact that in 1881 the legislative assembly passed an act to prevent the spread of yellows, and amended the same in 1884, shows clearly that the disease must have existed to an alarming extent. It is now less destructive, but still occurs in many parts of the district.

According to Mr. Beadle, peaches are grown to some extent in southwestern Ontario, in the counties of Norfolk, Elgin, Kent, and Essex, along Lake Erie. I am not informed whether yellows is there present, but I think it probable.

Indiana.—In Wayne County, Ind., yellows appeared as early as 1842, if we may credit the statements made December 24, 1850, by A. Hoover, of Centreville.³ He says:

All attempts to raise peach trees have proved unavailing for the last eight or ten years in consequence of the yellows.

There is nothing improbable in this statement, but as it stands alone without any description of the disease no special weight need be given to it. In later years, in the northern part of the State, not far from Michigan City, the disease is reported to have prevailed to a considerable extent. Peaches are not grown very extensively, except in southern Indiana, and I know nothing positive about the present distribution of yellows in that State.

Michigan.—Peach-growing in Michigan may for convenience be divided into an early, middle, and later period, the first and second periods ending, respectively, with 1839 and 1866.

Michigan was settled much more recently than southeastern Pennsylvania, New Jersey, Delaware, or eastern Maryland. Although a fertile soil and a favorable climate offered special inducements to set-

¹ *The Canadian Horticulturist*, 1878, p. 173.

² Letter of June 1, 1888.

³ *Patent Office Report (Agriculture)*, Washington, D. C., 1850, p. 375.

tlers, the tide of immigration flowed steadily past the State for many years, and did not set strongly into it until after 1830. Consequently peach-growing for commercial purposes was begun more than one hundred years later than in the Atlantic coast States. Seedling peaches were grown, however, in a small way all over southern Michigan from the time of the earliest settlements.

In Berrien County, prior to 1809, Mr. Burnett planted peach trees, some of which were living in 1829, twenty years after his death.¹ Two years later another pioneer, Samuel Wilson, found peaches growing in the Burnett orchard.²

At this time most of the settlers in Berrien County had a few seedling peach trees.

In 1834 Mr. Brodiss, who lived 6 miles northwest of Niles, "brought seedling peaches by the canoe-load down the St. Joseph River to peddle in Saint Joseph."³ In 1837 peaches were also brought into Saint Joseph from the Abbe orchard, said to have been set with improved trees sent from Rochester, N. Y.⁴

In Van Buren County, Dolphin Morris planted peach pits as early as 1830, and grew trees therefrom which lived many years.⁵ In 1836 Isaac Barnum brought peach pits from New York and planted in Van Buren County.

According to Harrison Hutchins, of Fennville, when the first whites settled in the lake-shore region of Allegan County, about 1835, they found a small peach orchard on Peach Orchard Point, on the Kalamazoo River, supposed to have been planted by French traders.⁶ The growing of seedling peaches by the settlers themselves began here soon after 1840.⁵

Mr. Hutchins, of Allegan County, also recalls that—

Before the war small "hookers" (boats) sometimes came to Saugatuck, and carried thence small loads of peaches, half grown and fuzzy, to sell in the more northern markets among the lumbermen. Their arrival was hailed by the pioneers as a good opportunity to dispose of a few surplus peaches, although they usually carried apples.⁶

In the central part of Allegan County Daniel Foster planted a small nursery of apple and peach trees soon after 1844. At this time most of the settlers in that part of Allegan had small peach orchards, grown from pits of their own planting.⁶ In 1849 an orchard of budded fruit was planted at Monterey and continued to be profitable for many years.⁶

¹ B. C. Hoyt in L. J. Merchant's *Catalogue of Fruit Growers and Shippers*, Saint Joseph, 1873; also *History of Saint Joseph*, by D. A. Winslow, 1869; both cited in *History of Michigan Horticulture*, by T. T. Lyon, 1887, pp. 236 and 237.

² *Cat. of Fruit Growers and Shippers*. Merchant. 1873. Lyon, p. 237.

³ *History of Michigan Horticulture*, by T. T. Lyon, Lansing, Mich., 1887, p. 268. Reprint from *Report of Sec'y of Mich. State Hort. Soc.*, 1887.

⁴ *History of Mich. Horticulture*, by T. T. Lyon, 1887, p. 296.

⁵ *Ibid.*, p. 297.

⁶ *Ibid.*, p. 292.

In Ottawa County many orchards were planted between 1836 and 1855, some of which contained peaches. In 1839 Allen Stoddard, of Ottawa County, sold peaches in Grand Rapids, from trees planted by his wife in 1836, around stumps in the clearings.¹ And as early as 1858, according to Frank Hall, George Lovell, of Ottawa County, planted a large peach orchard for commercial purposes.²

In 1839, at Saint Joseph, in the garden of B. C. Hoyt, grew the first peaches ever sent from Michigan to the Chicago market. These were seedlings.³ The next year Capt. Curtiss Boughton, of Saint Joseph, "bought peaches by the barrel and dry-goods box;" took them to Chicago on his vessel, and sold them at an enormous profit. This transaction induced many to plant peach trees.³

In 1842 Mr. Hoyt procured buds of improved varieties from William Prince, of Long Island, and started a peach nursery; but no improved fruit was shipped from Saint Joseph until 1844, when he sent over a few baskets of Crawfords.

After 1845 the shipment of choice fruit began to increase, beginning with a few hundred baskets of 3 pecks each, and reaching several thousand in 1855, when a great many Crawfords were shipped.³

In 1848 George Parmelee, of Benton Harbor, who afterwards became a celebrated fruit-grower, set his first peach orchard. This contained between 2 and 3 acres of budded trees. He continued planting peach orchards as rapidly as possible, until he had nearly 90 acres. In 1850 he set his first Crawfords. In 1873, the original orchard of 1848 was yet standing and contained "some of the largest and finest peach trees in the country."⁴

In 1849, Captain Boughton set out 130 budded trees in St. Joseph Township, south of St. Joseph river. In 1850 he shipped 250 barrels of seedlings and 150 barrels of improved varieties twice a week. The shipments for the year were by his vessel alone not less than 10,000 baskets.⁵

In 1857, the "Cincinnati" peach orchard, containing 65 acres, was set in Berrien County. "From this time the fruit interest commenced to grow rapidly, as one after another settled here and went into the business."⁶

At South Haven, Van Buren County, "during or soon after the year 1852, S. B. Morehouse and Randolph Densmore planted [peach] orchards north of the river. * * * Within the next few years Mr. James L. Reed planted an orchard * * * south of the village." In 1857 a

¹ *History of Mich. Horticulture*, by T. T. Lyon, 1887, p. 327.

² *Ibid.*, p. 329.

³ *Catalogue of Fruit Growers and Shippers*, by L. J. Merchant, Saint Joseph, 1873, Lyon, p. 237.

⁴ *History of Michigan Horticulture*, Lyon, p. 23; *Catalogue of Fruit Growers and Shippers*, L. J. Merchant, St. Joseph, 1873, Lyon, p. 238.

⁵ *Ibid.*, p. 238.

⁶ *Catalogue of Fruit Growers and Shippers*, L. J. Merchant, Saint Joseph, 1873, Lyon, p. 238.

peach nursery was established. In 1859, Aaron Eames planted from this nursery 4 acres of peach trees. Soon after 1861 John Williams planted a peach orchard.¹ Others planted orchards about this time.

In 1861 C. Engle, of Paw Paw, Van Buren County, planted 700 trees of Crawford's Early and Snow's Orange on an elevated ridge, he having noticed as early as 1850 that peach trees on high land in his vicinity endured the winters better.²

Peach growing for commercial purposes may be said to have begun in Michigan in 1848, but owing to lack of shipping facilities it did not assume proportions at all comparable to eastern interests until more than a decade later. Of this early period A. S. Dyckman, of South Haven, writes:

When about the end of the last half century Eleazar Morton, George Parmelee, and Curtis Boughton, the pioneers of Saint Joseph peach-culture, set their respective orchards—an aggregate area of 25 acres—people opened their eyes in amazement at this exhibition of lunacy, thinking the product of such large orchards would overstock the market.³

These references concern only those counties in which peach growing was begun earliest and has always held a prominent place. However, prior to 1860, according to Mr. Lyon,⁴ peaches had been grown successfully to a greater or less extent in at least fifteen other counties, for periods ranging from six years to upwards of thirty years.

In all of these counties through all of these years, from 1800 down, the peach grew thriflily and bore good crops. When not injured by borers or by those hard winters which every now and then killed or enfeebled some of the orchards, the peach tree was healthy, hardy, and long-lived.⁵ There was no yellows in any part of the State.

This disease, known for so long in the East, first appeared in Michigan in 1866 or 1867, in the extreme southwestern part of the State, in Berrien County. I have been at considerable pains to verify this statement and think it can be accepted unqualifiedly, or with only that general qualification given to all inductions which rest on a multitude of details, some of which have not been examined. In this case absolute proof would be nothing less than concurrent exact testimony concerning every peach tree ever grown in the State, but such rigid proof no one demands beyond the limits of the exact sciences. The belief that yellows did not appear in Michigan until 1866 rests upon the positive statements of hundreds of intelligent peach-growers and on the negative evidence of all the rest. Prior to 1866 the disease had destroyed thousands of acres of peach orchards in the Atlantic coast

¹ *History of Michigan Horticulture*, T. T. Lyon, 1887, p. 271.

² *Ibid.*, p. 269.

³ *Annual Report of Michigan State Pomological Society*, Lansing, Mich., 1873, p. 481.

⁴ *History of Michigan Horticulture*, Lansing, Mich., 1887.

⁵ See report of committee to Am. Pom. Society, September, 1852; *The Plough, Loom, and Anvil*, N. Y. and Phila., Vol. V, Part II, p. 39; A. J. Downing, *Fruits and Fruit Trees of America*, 1st edition and later editions.

region and was well known to fruit-growers as the worst enemy of the peach. For years the disease had been discussed and described in local and national horticultural gatherings; in conversations and personal correspondence; in newspapers, journals, and books. Exact and pretty full accounts of it had also been given in standard works on horticulture as early as 1828 by William Prince, in 1833 by Michael Floy, in 1845 by A. J. Downing, and later by others. Some of the Michigan peach-growers had seen the disease itself in various parts of the East, and all the more intelligent had the advantage of the accumulated knowledge and experience of others as detailed in the literature of a half century. Yet nowhere in the memory of individuals now living, or on the pages of our extensive and valuable horticultural literature, is there registered any recollection, statement, or inference tending to prove that the disease appeared earlier than 1866;¹ nor can I find any earlier account, vague or clear, of any other disease at all resembling it. In fact, a majority of the statements are that the disease appeared several years later than 1866. The general thrift and intelligence of the growers, coupled with the fact that many were already on the watch for yellows, renders it exceedingly improbable that this disease could have been present and unrecognized for any great length of time in a country devoted to peaches.

The disease first appeared in a circumscribed area near the village of Saint Joseph, within a few miles of Lake Michigan and in the most favored peach region of the State. According to W. A. Brown, of Benton Harbor, it is said to have appeared first on the lake shore 4 miles south of Saint Joseph, in the orchard of D. N. Brown, in trees brought from New Jersey and planted in 1862 or 1863.² It extended at first slowly, being confined to the vicinity of Benton Harbor for several years. Later it spread more and more rapidly, until by 1877-78 it was destructively prevalent in nearly every orchard in the county. The fact that at first it occurred only in a limited area, or sporadically, accounts for the various dates assigned for the first appearance of the disease, such as 1866,³ 1867-'68,⁴ 1868,⁵ 1869.⁶ It is certain that the disease was not prevalent enough to attract general attention or cause well

¹ W. K. Higley, in *Am. Naturalist*, 1881, pp. 849 and 961, states that yellows appeared in Berrien County in 1857. This date is possibly a misprint for 1867. He cites no authority, and so many misstatements and inaccuracies occur throughout his paper that in any event I would not be inclined to put much confidence in this date. The date 1862, given in *Annual Report Sec'y Mich. State Pom. Soc.*, 1878, p. 254, is a typographical error.

² Letter of July 17, 1888.

³ Nowlen. *Ann. Report Sec'y Mich. State Pom. Soc.*, 1873, p. 253, and W. A. Brown letter of July 17, 1888.

⁴ Cook & Bidwell. *Ann. Report Sec'y Mich. State Pom. Soc.*, 1872, p. 277.

⁵ A. R. Nowlen. *Ann. Report Sec'y Mich. State Pom. Soc.*, 1873, p. 22.

⁶ Winchester. *Condition of Growing Crops*. August, 1887, Dep't of Agriculture, Washington, D. C., p. 378.

founded alarm until after 1870. After 1875 few new orchards were planted and the old ones rapidly disappeared under its blighting influence. Even young orchards prematurely all their fruit within two or three years' time, and rapidly disappeared.

The progress of peach-growing in Berrien County from 1866, when yellows first appeared, to the culmination of the industry in 1874 or 1875 was almost phenomenal. Careful estimates of the number of peach trees in the fruit region of this county were made by private enterprise from time to time with the following results:

Year.	No. of trees.
1865	¹ 201,603
1869	¹ 385,530
1872	² 594,467

In 1865, a canvass showed that only about two hundred and fifty persons were engaged in fruit-raising; in 1872 the number had increased to over eight hundred.³

In 1871, according to Charles W. Garfield, who then first saw the Saint Joseph region, the peach orchards were everywhere.⁴

1872, Mr. Clubb says:⁵

Benton Harbor has excellent shipping facilities and the country for miles around is a continuous peach orchard, interspersed with cherry, plum, pear, and apple orchards.

In January, 1873, L. J. Merchant writes:⁶

Only a few years ago this section of country was generally covered with heavy timber; now it is an almost unbroken mass of fruit trees and vines. Then there were only a few roughly constructed houses, where dwelt the hardy pioneers; now the country is thickly dotted with handsome residences, the abodes of wealthy fruit-growers, and millions of dollars are invested in the business of fruit culture.

In 1873, J. E. Chamberlain declared the number of peach trees in the fruit region of Berrien County to be not less than 600,000 by actual count.⁷ A. S. Dyckman made a similar statement in 1874.⁸ Both apparently based their statements on the careful canvass made by Mr. Merchant in 1872.

The peach shipments, by water, from Berrien County in 1877 were estimated by John Whittlesey, of Saint Joseph, at 422,225 baskets. A few baskets went also by railroad.⁹

¹ *History of Michigan Horticulture.* Lyon, p. 241.

² "Accurate canvass of eight of the principal fruit-growing townships," by L. J. Merchant, *l. c.*, p. 53. Lyon, p. 240.

³ Merchant, Lyon, p. 238.

⁴ *Annual Report Sec. Mich. State Hort. Society, 1880,* Lansing, Mich., p. 275.

⁵ *A Sketch of Northern Michigan,* by Henry S. Clubb. *Rules and regulations, etc., of the great Union Fair of Michigan.* Grand Haven, 1872.

⁶ *Catalogue of Fruit Growers and Shippers.* Saint Joseph, 1873. Lyon, p. 238.

⁷ *Annual Report Sec. of Mich. State Pom. Society, 1873,* p. 26.

⁸ *History of Michigan Horticulture,* Lyon, p. 48.

⁹ *Ibid.*, p. 241.

From about 1870 we begin to meet frequent references to the ravages of yellows.

In 1871, by invitation of the Berrien County Horticultural Association, Dr. R. C. Kedzie visited Benton Harbor and examined many trees having all the characteristics of yellows.¹

In 1872 "L. T." states that yellows has commenced its destructive work at Saint Joseph, Mich., where he has a twenty-acre orchard.²

In April, 1873, L. Collins, of Saint Joseph, says:

We have the disease called yellows among our trees and that to an alarming extent. I have lost one orchard of 800 trees entirely by the disease.³

In 1872, Messrs. Cook and Bidwell⁴ found yellows more or less "in every direction from Benton Harbor." It extended northeast 12 miles, as far as Watervliet and Paw Paw Lake, in the extreme north part of the county. They state that:

The disease has probably existed in the vicinity five years. The exact time of its advent is not known. The people have tried to believe that it was not the yellows, but the result of peculiar soil or seasons. But the fact can no longer be concealed. They have "the yellows" in its most aggravated form.

In April, 1873, A. R. Nowlen, of Benton Harbor, says:⁵

I think the disease made its appearance five years ago [1868] for the first time, and in various orchards several miles distant from each other simultaneously.

In 1873 a committee, consisting of Prof. J. C. Holmes, H. G. Wells, and S. O. Knapp, were appointed by the State Pomological Society to make a report upon yellows in Michigan. During that year these gentlemen spent nine days, July 30 to August 7, in southwestern Michigan searching for the disease. They found it only at Saint Joseph, Benton Harbor, and South Haven. No diseased trees were seen north of South Haven, nor many anywhere; but the trip was too hasty to permit of thorough examination. They talked with many peach-growers and concluded that the disease was not widely prevalent.⁶ Among others the following well-known peach-growers reported to this committee that yellows was not present in their locality: E. D. Lay, Ypsilanti; T. T. Lyon, Plymouth; I. S. Linderman, Casco; Henry S. Clubb, Grand Haven; C. J. Dietrich, Grand Rapids; D. R. Waters, Spring Lake; S. B. Peck, Muskegon; J. D. Husted, Lowell; S. L. Morris, Holland; and C. Engle, Paw Paw.

¹ Yellows in Peaches, by Dr. R. C. Kedzie. *Report of Secretary of Mich. State Pom. Society*, 1872, pp. 464-83.

² *The Gardeners' Monthly*, Philadelphia, 1872, p. 118.

³ *Annual Report Sec'y Mich. State Pom. Society*, 1873, p. 23.

⁴ *Ibid.*, 1872, p. 277.

⁵ *Ibid.*, 1873, p. 22. On p. 253 of the same report Mr. Nowlen is credited with the statement that yellows first appeared at Benton Harbor in 1866.

⁶ Report on peach yellows. *Annual Report Sec'y Mich. State Pom. Society*, 1873, pp. 11-37.

Four years later, in The Annual Report of the Secretary of the Michigan State Pomological Society,¹ it is stated that at Benton Harbor and Saint Joseph, "they are giving up peaches on account of the yellows." These villages are both on Lake Michigan and only about 3 miles apart. The same year a Benton Harbor correspondent of The Cultivator and Country Gentleman² says: "We have lost most of our trees in this region by yellows." The same year the same journal³ quoted from T. T. Lyon: "This violent and contagious disease has nearly destroyed the peach orchards at Saint Joseph."

In 1880, says Charles W. Garfield, there were scarcely any peach orchards left at Saint Joseph. The growers attributed their destruction to the yellows.⁴

In 1878, W. A. Brown, of Benton Harbor, writes:⁵

The disease is supposed to have been introduced in this vicinity about the year 1866, by means of trees imported from New Jersey, which had been grown from the buds of infected trees. But few trees were so affected, and it was several years later when the disease in the vicinity of Benton Harbor first assumed a contagious type. A few trees in the large orchards south of Saint Joseph showed signs of yellows, but the character of the disease being known, such trees were immediately destroyed, and many fine crops were grown before the trees were all affected. The area of country infected was comparatively small until the past two seasons [1877 and 1878], when the disease has assumed a more virulent character, and has spread over all of Berrien County, excepting a small portion in the extreme southern part.

In 1887, A. O. Winchester, of Saint Joseph, writes:⁶

We do not know where it came from or how introduced. * * * The disease first appeared [first destructively] in the center of the peach belt eighteen years ago, and gradually spread north and south along the lake shore until there was not a healthy orchard left.

This is not an overdrawn picture. No one who knows the character of the authorities cited will doubt the general correctness of the foregoing statements. Indeed, were further proof necessary, a great mass of additional testimony might be brought forward. The peach industry was literally swept out of Berrien County by yellows within one decade. There can be no doubt of this. From being the foremost peach county in Michigan, with an acreage more than equal to that of all the others combined, it became ninth in order, and could boast of only 503 acres. In other words, with a prospect of an expanse in peach growing which would be limited only by market facilities and the ordinary accidents of culture, the yellows appeared in destructive form, and the industry gradually fell away to about one-twelfth of its former proportions.

¹ 1877, p. 402.

² Albany, N. Y., 1877, p. 72.

³ Page 765.

⁴ *Annual Report Sec'y Mich. State Hort. Society*, 1880, p. 275.

⁵ *Annual Report Sec'y Mich. State Pom. Society*, 1878, p. 254.

⁶ *Condition of Growing Crops*, August, 1887, Dept. of Agriculture, Washington, D. C., p. 378.

The exact figures for 1874 can not be obtained, but the following statement is approximately correct :

Peach industry in Berrien County, Mich.¹

Year.	Acres.	Number of trees.
1874.....	6,000	654,000
1884.....	503	54,827

From the immediate vicinity of Benton Harbor and Saint Joseph, peach growing disappeared almost completely. In 1884, the townships of Benton and Saint Joseph contained only 47 acres of peach orchard, and the entire north part of the county, including these two townships and seven others, had an aggregate of barely 210 acres. Even these figures do not tell the whole truth. In the townships of Benton and Saint Joseph the *bearing trees* numbered at this time *only* 757, and in the entire nine counties, aggregating about 225 square miles, they numbered only 6,668.²

Many peach orchards have been planted in Berrien County since 1884, but it remains to be seen whether these will escape the disease which raged in the last decade. At present it looks as if they might.

T. T. Lyon, of South Haven, states that the disease appeared in the central part of Van Buren County somewhat earlier than at South Haven, following, as he thinks, the line of the railroad from Berrien County, northeast,³ *i. e.*, being disseminated from nurseries.

Yellows first appeared upon the lake shore, at South Haven, in 1869, in the orchard of Rossiter Hoppin. Although it finally destroyed most of the trees in that orchard and appeared in many others, it did not spread rapidly at first. Messrs. Holmes, Wells, and Knapp (*l. c.*) found the disease there in 1873 in three orchards only, and but to a very limited extent, *i. e.*, one orchard contained 1 tree; one, 2 trees; and one, 4 or 5 trees.

In 1873 a committee was also appointed by the South Haven Pomological Society to inquire into the existence of yellows at South Haven. This committee, consisting of H. E. Bidwell, H. Linderman, and John

¹ These figures are based in part on Mr. Merchant's canvass, in part on the State census of 1874 and 1884. The Michigan census report of 1874 does not give the number of acres of peach orchard by itself, but only the combined acreage of apples, peaches, pears, cherries, and plums, which was 14,001 acres, cherries, plums, and pears being cultivated to a small extent only, as shown by the bushels of fruit produced in 1872 and 1873. I have no doubt that 8,000 acres of peaches would be nearer the actual acreage of 1874, but give the smaller number to be entirely safe. The number of trees for each year is assumed to have been one hundred and nine times the number of acres, one hundred and nine being the usual number of trees set on an acre. The actual number of *bearing trees* given in the census report of 1884 is only 26,419.

² *Census of Michigan, 1884*, Vol. II, Table VII, p. 223.

³ *History of Michigan Horticulture*, Lyon, 1887, p. 272.

Williams, reported July 3, 1874, that, with the consent and assistance of the owners, they had removed a few cases of the disease from three orchards, and that "some traces of it" yet remained. On August 22, 1874, the same committee reported again as follows:

Your committee, who were appointed to examine the peaches in this vicinity to see if any yellows could be found, and if so to have them removed, beg leave to report: That where traces of it were found one and two years ago, and then removed, none now can be found; and where new trees are set in their places they are growing finely, and to all appearances healthy. In one case two years ago [1872] the owner tried to cut it out of the tree by cutting off the affected limb, but last season he found that and three adjoining trees affected. These were carefully removed, and no traces of the disease can now be found in his orchard. A similar case was found last season, where two peaches were found diseased on the end of a limb, which limb was removed as soon as the peaches were discovered to be diseased. On a recent examination this tree was found to be covered with diseased peaches, and several other trees in the neighborhood were likewise found affected in whole or in part, which have all been removed.¹

South Haven peach-growers knew of the existence of yellows in Berrien County, that village being only about 20 miles north of Benton Harbor. They were therefore on the lookout for its appearance in their own orchards, the nearness of the danger making them specially watchful. Under such conditions yellows could not have existed long without detection, and there is no reason for supposing it existed at all until 1869.² It did not become general until considerably later. Finally, however, it destroyed many trees and some whole orchards, the Hoppin orchard, among others.

The condition of peach-growing at South Haven prior to 1860 has already been noted. During the next ten or twelve years many peach orchards were planted. In 1864 A. S. Dyckman, one of the large growers, shipped 600 baskets; in 1872 he shipped 12,000 baskets. After 1870 the planting of peach orchards increased with special rapidity, owing in part, it may be presumed, to discouragements in Western Berrien arising from yellows, but chiefly to the increased facilities for shipment due to the dredging of the harbor and to the building of a railroad.³

The disease appeared first in a few trees and in a few orchards only, gradually extending to others. According to Mr. Lyon⁴ there was not much yellows at South Haven "until after the severe winter of 1874-'75, when about 5 per cent. of the trees were found diseased and

¹ *Annual Report of the Secretary of the Mich. State Pom. Soc., 1874*, p. 496.

² A. S. Dyckman and other peach-growers, whom I met at South Haven in April, 1888, all agreed that the yellows first appeared in the Hoppin orchard. They also agreed that it was prior to 1872, but could not give the exact date. By them I was referred to Charles Gibson, as one who had had much to do with this orchard and who would be likely to remember the year. Mr. Gibson says the yellows first appeared at South Haven in 1869, and first in this orchard. Letter of May 21, 1888. The trees set in this orchard were procured at Saint Joseph, Mich., and yellows appeared in them when they were three or four years old.—[Mr. Gibson, letter of November 30, 1888.

³ *History of Mich. Hort.*, Lyon, p. 272.

⁴ *Annual Report of the Sec'y of the Mich. State Hort. Soc., 1880*, p. 274.

taken out. Afterwards, until this year [1880], there was very little of the disease manifest. This year the disease shows an increase."

In 1878 A. G. Gulley, of South Haven, writes:¹

At least 5,000 trees have been destroyed by this disease the past season [1878] in this county alone.

In 1882 Secretary J. G. Ramsdell, of South Haven, writes:²

That dreaded scourge of the peach-grower, yellows, has made slow but marked progress during the year in this locality.

In 1883 Joseph Lannin, of South Haven, writes:³

We think we are holding the disease in check by promptly destroying the trees on the first manifestation of the disease. If, however, the yellows continues to spread, it will be only a question of years when peach-growing will cease on the lake shore.

In 1888, Mr. Lannin told me he had lost his entire orchard. His neighbors, however, think it might have been saved by a prompt and full compliance with the law.

The yellows is still present at South Haven, but is no longer a source of alarm.

Speaking of the advent of yellows, Mr. Lyon says:⁴

The peach interest at that time was already extensive and the trees were free from disease.

Other South Haven growers⁵ testify to the previous freedom of the peach tree from disease. We may therefore conclude that peaches were cultivated at South Haven for a period of at least sixteen years, 1852-'6', unmolested by yellows.

Yellows first appeared at Lawton, in southeastern Van Buren, in 1878. This village is 30 miles east of Benton Harbor and 25 miles southeast of South Haven. Here, as elsewhere, peach-growers being forewarned, were on the watch for the disease and presumably detected it very soon after its appearance.

Peach-growing for commercial purposes began at Lawton in 1860, when N. H. Bitley planted 500 trees. These trees bore their first crop in 1866, soon after which several other orchards were planted. Later occurred a very general planting, so that in 1878, when yellows appeared, there were about 150,000 peach trees in the vicinity of Lawton.⁶

Hon. C. D. Lawton, of Lawton, writes as follows:⁷

The first appearance of the yellows here was in 1878. I think it had appeared in Mr. Engle's orchard near Paw Paw [4 or 5 miles distant] the year previous to 1878, but that was the season we first recognized the disease here. Peach trees have grown here since the first settlement of the region. The first orchard for market

¹ Annual Report of the Sec'y of the Mich. State Pom. Soc., 1878, pp. 249-253.

² Annual Report of the Sec'y of the Mich. State Hort. Soc., 1882, p. 306.

³ *Ibid.*, 1884, p. 11.

⁴ Letter of January 19, 1888.

⁵ Dyckman, Lannin, Gulley, and several others, whom I met at South Haven in 1888.

⁶ History of Mich. Hort., Lyon, p. 269.

⁷ Letter of January 24, 1888.

—500 trees—was set by Mr. N. H. Bitley in 1858, and it survived and bore finely for twenty years, until destroyed by severe winters and the yellows. No finer, healthier peach trees or peach orchards exist anywhere than were found here up to a few years ago. We have had several very severe winters, 1884, '85, '86, during which many trees were injured or destroyed. This, added to the ravages of the yellows, has caused our peach orchards to look somewhat ragged.

¹ In the season of 1881 there were shipped from this station upwards of 100,000 baskets of peaches, in 1883 perhaps as many, and possibly as many in 1887.¹

Up to about 1875 there were not many shippers. There were but few orchards. Still there were some that were proving profitable, and the success of these few induced others to set out trees. The yellows seems to have gradually spread here from Benton Harbor. We heard of its appearance in the west part of the county a few years before we discovered it here, and were looking out for it, anticipating its arrival.

At Lawton peach-growing has not been abandoned, although entire orchards have been ruined.

Yellows does not appear to have worked as disastrously in Van Buren County as in Berrien, owing possibly to the timely and rather strict enforcement of the yellows law. This phase of the problem will be considered later, under "restrictive legislation." In 1884 the State census credited Van Buren County with 2,181 acres of peach orchard, a small acreage, considering its favorable situation, but enough to show that peaches can still be grown in spite of yellows. In 1888 Mr. Lyon says of South Haven, the best peach region in the county, "the acreage planted is largely increasing from year to year."²

At Douglas, Allegan County, yellows appeared in 1873 or 1874, simultaneously in at least two different orchards several miles apart. This village is 17 miles north of South Haven and a few miles only from the lake shore. Rev. J. F. Taylor, for six years yellows commissioner of Saugatuck Township and for twenty years a resident, writes as follows concerning the appearance of the disease in that locality.³

Yellows appeared here first in 1873 or 1874. In an orchard south of mine about 2 miles [orchard of Robert Linn] one tree produced some beautiful red fruit. No one knew the cause of the changed color. This orchard contained about 300 trees. After this tree had borne such fruit a year or two it was pronounced diseased with yellows. The man refused to cut it down, and in about eight years all of his trees (300) were dead by the effects of this contagious disease. The same year (1873 or 1874), 2 miles east of my orchard, another man [D. W. Wiley]⁴ found three or four trees in his orchard of 6,000 trees which had the yellows. He did not know the appearance of affected fruit and went to Saint Joseph to learn what effect the yellows had on tree and fruit. He cut and dug out these trees and planted new ones in their places, which grew and bore [healthy] fruit. This orchard has suffered but little from yellows.

¹ Michigan peach baskets hold from one-fourth to one-fifth bushel. The honest ones hold one-fourth bushel.

² Letter of January 13, 1888.

³ Letter of January 25, 1888.

⁴ Mr. Wiley himself says yellows first appeared in his orchard in 1874 in six trees of Crawford's Early, all heavily laden with fruit.

Yellows does not appear to have spread rapidly at first. Harrison Hutchins, of a neighboring village, himself a well-known peach-grower, writes:¹

Peach yellows made its appearance on the lake shore [12 to 14 miles north of South Haven] about ten years ago, and one or two years later [1878 or 1879] about Fennville, $6\frac{1}{2}$ miles east of the lake.

Peaches were grown in the lake shore townships from the earliest settlement (*l. c.*); commercial orchards were planted in 1862, and by 1872 the business of peach growing had become general.² Two years later, 1874, Henry S. Clubb made a careful canvass and found that in two townships only, Ganges and Saugatuck, the number of peach trees in orchard exceeded 62,000.³ The name of each grower is given and the number of acres or the number of trees. There are many comments on the healthy appearance of individual orchards, and no mention is made of yellows.⁴

In other words, peaches were grown in western Allegan in constantly increasing numbers, unmolested by yellows for a period of not less than thirty years, even on the assumption that the disease appeared there considerably earlier than the earliest date assigned.

G. H. La Fleur, a nurseryman at Millgrove, says that yellows first appeared in the township of Casco⁵ in or about the year 1874. "From that point it gradually spread until it reached Ganges and Saugatuck. I first saw it at Fennville in 1876." Three years after its appearance at Fennville, yellows appeared in Allegan Township⁶ on a favorable elevation, in an orchard growing on some of the best soil in the county.⁶

Mr. La Fleur adds:

I think the disease prevails in nearly every town in the county where peach trees are growing, although some parts are almost exempt as yet.

In answer to inquiries concerning the extent of injury done to orchards about Fennville, Mr. Hutchins writes:⁷

I think one-tenth of all bearing trees has been affected with yellows; not nearly as large a per cent near the lake. I am $1\frac{1}{2}$ miles west of Fennville, and out of 5,000 bearing trees I have lost nearly 5 per cent.

¹Letter of January 27, 1888.

²Hutchins, cited in *History of Michigan Horticulture*, p. 297; Clubb, *l. c.*

³The *Saugatuck and Ganges Fruit Region*, etc., by Henry S. Clubb. Published by the Lake Shore Agricultural and Pomological Society. Douglas, Allegan County, Mich., 1875, pp. 1-20.

⁴The number of peach trees in Ganges and Saugatuck ten years later (1884) was 237,391. (*Census of Michigan, 1884*, Vol. II., p. 220.)

⁵The townships of Casco, Ganges, and Saugatuck front on Lake Michigan for a distance of 18 miles. They are the most important peach townships in Allegan County. Casco is contiguous to South Haven, in Van Buren County; Ganges joins Casco on the north; Saugatuck joins Ganges on the north. Allegan Township is due east of Ganges, separated by two townships each 6 miles broad; it is about 15 miles south east of Fennville.

⁶Letter of February 6, 1888.

⁷Letter of January 27, 1888.

To the question: Has peach growing been discouraged to any great extent by yellows? he replies:

I think not. In some few instances, perhaps, but not generally.

To similar inquiries respecting Saugatuck Township, Rev. J. F. Taylor makes a similar reply.

In western Allegan, as a whole, peach growing is on the increase. According to Harrison Hutchins,¹ almost every farmer has a peach orchard, varying in number of trees from a few hundred to 5,000 or even 10,000.

Respecting the eastern part of Allegan County, G. H. La Fleur states that yellows has reduced the number of trees 50 per cent., although many are planted each year.²

The State census of 1884 shows that peach growing is fairly prosperous in Allegan County, the acreage there given being more than double that of any other county, *i. e.*, 8,367 acres, corresponding to about 900,000 trees.

In remoter parts of Michigan peach yellows appeared at dates much later than 1869. Peaches have been grown in Ottawa and Kent Counties for thirty years or more. In 1884 Ottawa was credited with 984 acres, containing 84,223 bearing trees; and Kent was credited with 3,362 acres, containing 161,065 bearing trees. Nevertheless yellows did not appear in either county until within the last eight or ten years. In the vicinity of Grand Rapids the disease did not appear earlier than 1883, although peaches have been grown since 1850 and to a very considerable extent since 1875. Farther north, in the Grand Traverse region, where peaches have been grown to a limited extent since 1865, it is said that the disease has not yet appeared. On the eastern side of the State, it was not present at Plymouth, Wayne County, in 1873,³ and has not been reported from Oakland County, where in 1884 were 1,093 acres, containing 44,320 bearing trees.

In the vicinity of Ann Arbor, peach trees were planted as early as 1842, and peach-growing has been a considerable industry since 1875. In 1884 the number of bearing trees in the city and township was 59,592 (446 acres), and many have been planted since that date, yet the orchards have never suffered from yellows. Indeed, I can not find that a single case has ever appeared. I have myself examined many trees.

In view of some inquiries to be made later respecting climate as a cause of peach yellows, it will be necessary to note briefly the conditions under which peaches are grown in Michigan, particularly as these conditions vary somewhat from those found in the Chesapeake and Delaware region. As a whole the climate of Michigan is too severe for the peach. Bitter experience has shown that the excessive cold and the

¹ *History of Michigan Horticulture.* Lyon, p. 297.

² Letter of February 6, 1888.

³ T. T. Lyon, *Report of the Secretary of the Michigan State Pomological Society, 1873,* p. 27.

rapid temperature changes of some of the Michigan winters are sufficient to kill entire orchards. So much depends, however, upon location that no general rule can be laid down, other than that in the interior and on the east side of the State the peach does not winter well north of latitude 43° . South of this, in favored localities, the peach has passed through the severest winters in safety.

What is known as the "peach belt" is a narrow strip of sandy and loamy land in the extreme southwestern part of the State, bordering on Lake Michigan. There peaches were first planted for commercial purposes; there their cultivation has been most uniformly successful; and there it still involves the largest amount of capital. The reason for this, aside from proximity to a great market, lies in the nearness to a large body of water. The prevailing winter and spring winds being from points between northwest and southwest must pass over Lake Michigan on their way to the peach orchards, and during this passage they lose much of their severity by contact with the warmer water. In winter the temperature never falls as low along the lake as in the interior or on the eastern side of the State, and the extremes of temperature are neither so sudden nor so great. In the spring the lake water is cooler than the air, and the winds which then blow over it lose some of their warmth, and the vegetation in the orchards is retarded until there is little danger of frost. The equalizing influence of this great body of water is very considerable. In southwestern Michigan peaches can be grown almost as successfully as in Delaware, and near the lake can be grown to some extent even as far north as latitude $45^{\circ}30'$. On the contrary, in northern Illinois and in Wisconsin, on the west side of the lake and exposed to land winds, peaches are not grown in open orchards at all north of latitude 42° , and very little north of latitude 40° . At Madison, Wis., latitude 43° , peaches will not ordinarily live through a single winter. The same may be said of all that part of Wisconsin due west of the great peach orchards of Allegan County, Mich. What is true of Wisconsin and northern Illinois is said to be true also of the northern half of Indiana.

In recent years it has been found that peaches can be grown anywhere in central and western Michigan south of latitude 43° , if the right locations are selected. These are hills and table-lands. Trees on hill-tops pass safely through winters which destroy whole orchards in valleys and bottom lands. This fact is now so well understood that away from the lake it is rare to find an orchard on low land. The orchards at Ann Arbor, Lawton, Paw Paw, and Grand Rapids are all on the highest hills.

To express the same fact somewhat differently, we may say that while the peach region *par excellence* lies in the southwest along Lake Michigan, peaches may also be grown more or less successfully south of an irregular line running northwest from Lake Erie to Grand River, and thence along the lake to near the northern end of the southern peninsula. The chief

peach counties outside of the most favored region are Monroe, Kalamazoo, Jackson, Washtenaw, Ionia, Kent, Muskegon, and Grand Traverse, in some of which yellows has not yet appeared, and in none of which has it been present for any great length of time.

To the question, "Do peach trees continue to be planted in Michigan?" there is no official reply later than that given in the State census for 1884. The number of acres of peach orchards in Michigan at that time was 24,502, containing 1,428,209 bearing trees. Assuming that there were one hundred and nine times as many trees as acres, the number of trees not in bearing, *i. e.*, planted recently, would be 1,242,509. Aside from this evidence we know that peach-growing has rapidly increased of late in many places, and as it has encountered no new or unusual obstacles since 1884, it is safe to assume that what was then true of the State as a whole continues to be true. In other words, we may safely conclude that one-half of all the peach trees in Michigan have been set within the last four or five years, and probably as many as one-fourth within the last two years.

Summary.—So far as its present distribution is concerned, we may infer that the disease occurs, or is likely to occur, anywhere in Pennsylvania, New York, Ontario, Ohio, Indiana, Illinois, and Michigan.

It is also certain that the disease did not appear in the West until at least a half century after it had ravaged Eastern orchards nor until many years after the introduction of the peach.

3. SOUTHWESTWARD MOVEMENT.—Although not in strict sequence it seemed best to treat of the southern movement of yellows in New Jersey along with its appearance in other parts of that State, so that there now remains for consideration only the southwestward extension of the disease into Delaware, Maryland, Virginia, and States farther to the south and west.

Delaware.—The annals of peach-growing in Delaware are not complete enough to form a perfect record from the earliest settlements down. Some mention, however, has already been made of early peach-growing in this region. Orchards of seedling peaches, some of them of large extent, were grown in all parts of Delaware from the earliest settlements. These early orchards appear to have been entirely free from disease. Even at the beginning of the present century the orchards grew vigorously and reached a great age.¹ From this we may infer that yellows was unknown, save possibly in the extreme north end of the State. In fact, the peach appears to have been cultivated throughout Delaware with almost uniform success until a time within the memory of men now living, a time concerning which I have succeeded in obtaining reasonably exact information, though not without much inquiry. The trees of the early period were all natural fruit, *i. e.*, unbudded. The orchards of to-day are all choice budded varieties.

Peach growing on a large scale for commercial purposes, other than

¹ See page 20.

the manufacture of brandy, began in northern Delaware in 1832, and for the needs of this report it will be sufficient to make this date the starting point of our inquiry. For reasons which will be apparent later, I shall also first consider upper Delaware, then middle, then lower, corresponding respectively to the counties of New Castle, Kent, and Sussex.

New Castle.—The soil of New Castle County contains a larger proportion of clay than that of Kent and Sussex, and the land is more rolling, although not stony and not hilly, even in the extreme north part. The soil, of course, varies somewhat in different parts of the county; there is some rather stiff clay, a good deal of loam, and some light sand, especially near Delaware River. The subsoil is clay. The original timber was a good growth of white and red oak, chestnut, sassafras, tulip tree, etc. The land has been under cultivation for periods ranging from forty to one hundred years, or more. It is in the main a fertile soil, but some of it has been very heavily cropped. The present state of farming, as regards stock raising, use of fertilizers, etc., will compare favorably with that of other thrifty sections of the United States. Wheat and Indian corn were formerly the staple crops, and with the decline of the peach industry these have again become of prime importance.

To Isaac Reeves belongs the honor of having demonstrated that peaches might profitably take the place of wheat and other ordinary farm crops. Since his day, Delaware from one end to the other has been very literally one succession of great orchards and gardens. Mr. Reeves, a native of New Jersey, but then a resident of Philadelphia, induced Jacob Ridgeway, a wealthy citizen of that place, to embark with him in the new enterprise; and in the spring of 1832, 1 mile from Delaware City, near the Delaware and Chesapeake Canal, on a farm belonging to Mr. Ridgeway, they set out 20 acres of budded peach trees, with a view to supplying the Philadelphia market. This was the first large market orchard ever set in New Castle County. To this plantation they added 40 acres in 1833, 20 acres in 1835, and 20 acres in 1836, making a total of 110 acres. An additional 20 acres was set out in 1847, but not until all of those previously set were about to be removed.

The experiment of Messrs. Reeves and Ridgeway proved successful beyond expectation. The trees were healthy, grew vigorously, and after a few years returned bountiful crops; so that one year the gross receipts from sales of fruit was \$16,000, peaches then bringing from \$1.25 to \$3 per basket of 3 pecks.

Peach growing on such an extensive and successful scale could not fail to attract general attention, and have many competitors. In 1836, on the Union Farm, on Delaware River, midway between Wilmington and New Castle, James W. Thompson and Manuel Eyre set 140 acres of peach trees. In 1835, or thereabouts, Maj. Phillip Reybold set his first orchard on the mellow, loamy soil near Delaware City. In 1838 he set another large orchard, and continued to set orchards in that vicinity

until 1842, when he had 12,960 trees, covering 120 acres. In this business he was followed, between the years 1837 and 1840, by his four sons, the Clark Brothers, and many others, all of whom appear to have found the peach industry more profitable than wheat growing or any other business in which they were engaged. Concerning Delaware City, Dr. F. S. Dunlap, to whom I am indebted for many interesting statements, writes as follows: "In 1840 one-half of this section was covered with magnificent peach orchards, the most of which continued in successful bearing until 1848 to 1850." James W. Thompson, whom A. J. Downing styled "one of the most intelligent orchardists in the country," declares, in March, 1846, that "from 2,500 to 3,000 acres of land in New Castle County are planted with and successfully cultivated in peaches, making Delaware, though the smallest of the States, the largest producer of this fruit." This appears to have been a very moderate estimate, for in 1845, according to James Pedder,¹ Major Reybold and his sons alone had 117,720 trees, covering 1,090 acres, from which, during August of that year, there were shipped 63,344 baskets of fruit. The fact that Phillip Reybold, jr., then had from 60,000 to 80,000 young peach trees in his nursery is also an indication of the extent to which peaches were being planted. In 1848 the peach crop of Delaware, chiefly from New Castle, was estimated at 500,000 baskets, of which the Reybolds furnished about one-fourth.²

During some of these years the product of the peach orchards was far in excess of the facilities for shipment, and even of the demand, so that thousands of baskets remained unpicked, and other thousands were thrown away upon reaching market.

The great body of the orchards at this time appears to have been in the vicinity of Delaware River, in the Hundreds of New Castle, Red Lion, and upper Saint George, on a strip of gently rolling, sandy, and loamy land, 10 or 15 miles in length by half as many in breadth. It is said that a considerable portion of this land had been considered unfit for agricultural uses, and at the beginning of the century was an uninclosed wilderness, Major Reybold having purchased a great tract of it at a nominal price.³

The trees were set from 20 to 30 feet apart and were tilled in corn the first three years, after which the orchards were kept fallow. The trees were examined twice a year for borers and in some orchards it was also the custom to thin out the fruit while it was small that what remained might grow the better.⁴

In 1837 The Wilmington Journal gives some account of the success of Mr. Ridgeway's orchards, which would that year, it was estimated,

¹Quoted from *The Boston Cultivator* in *Annual Report of the Commissioner of Patents (Agriculture)*, 1845, pp. 954, 955.

²*Annual Report of the Commissioner of Patents (Agriculture)*, 1848, pp. 161 and 465.

³William C. Lodge, *l. c.*

⁴James W. Thompson, *l. c.* : *The New Am. Orchardist*, by William Kenrick, 8th ed., 1848, Boston, p. 204.

yield a profit of \$20,000, and concludes as follows: "We add to this statement that there is no part of our country which is more favorable to the production of this delicious fruit than the vicinity of Delaware City, and the whole district of country lying along the western shore of the Delaware and extending from Christiana down to Bombay Hook,"¹ *i. e.*, the whole eastern side of New Castle County. This statement was then undoubtedly true and would still be true but for peach yellows. Indeed, from the days of Campanius down to a very recent date the peach appears to have flourished along the Delaware River in full vigor, even when neglected.

As nearly as can be determined now yellows first appeared on the Ridgeway farm in 1842, *i. e.*, ten years after the first orchard was planted.² It did not first appear in the orchard planted in 1832, nor yet in the ones planted in 1833 and 1835, but in the orchard planted in 1836. This orchard showed yellows six years after planting and was worthless at the end of ten years. The orchard planted in 1835 showed yellows in nine years, *i. e.*, in 1844. By 1845, both orchards were badly diseased, especially the younger one, and both were removed in 1847. The orchards of 1832 and 1833 were also removed at this time. The orchard of 1832 remained in good bearing longer than any of the rest. Col. James Bowen, an orchard foreman for Isaac Reeves, states that for a period of thirteen years this orchard never failed to produce a fair crop, and that a few of the trees left standing continued to produce good fruit until 1852. According to Colonel Bowen and Clement Reeves, a son of Isaac Reeves, neither this orchard nor the one set in 1833 ever showed yellows. This statement, however, may not be strictly true, for after 1844 a number of trees in both orchards are said to have prematurely from the effect of borers, bad pruning, and neglect, and some of these may have had yellows.

One of the most interesting facts in connection with the history of these orchards is that the fifth and last orchard, set in 1847 when yellows was very prevalent, "went out" more quickly than any of the others. This orchard "bore but three crops; the middle crop, at four years of age, was a large and fine crop. The third crop [1852] was neither abundant nor of good quality. The next year the trees were all either premature or yellow." Clement Reeves, who set this orchard and who now lives at Delaware City, says it was thrifty and apparently healthy until it had been planted four years. The yellows made such quick work that it was dug out in 1855, eight years after it was planted.³

There can be no doubt as to the nature of this malady. William Reybold and other peach-growers, who were eye witnesses, unite in stating that the disease which destroyed the orchards was yellows, and

¹ Quoted in Ruffin's *Farmers' Register*, Pittsburgh, Va., 1837, p. 459.

² In 1843, according to John Delano, Isaac Reeves's peach trees were dying of yellows by the score "mangre all his care, cultivation, and circumspection." *The Cultivator*, Albany, 1843, p. 167.

³ F. S. Dunlap, M. D. Letter of January 17, 1888.

say that any one familiar with peach-growing can hardly mistake this disease. Dr. Dunlap writes :

When the disease first made its appearance here I was but a lad and too young to take much interest in peach culture, yet I well remember the sad havoc it made in our orchards.

He has no doubt as to its being identical with the yellows now present in Delaware. Other testimony is not wanting as to the existence of yellows in this region at that time.

Indeed, according to Dr. Black¹ yellows has been known on the Delaware and Chesapeake peninsula "since the war of 1812, and is supposed to have been introduced from Pennsylvania, by carrying down improved trees, but it never amounted to a scourge until large orchards began to be cultivated from budded fruit."

In 1846, James W. Thompson, of Wilmington, complains of it as a "constitutional, consumptive, or marasmatic disease * * * by far the most destructive enemy of the peach tree." Mr. T. adds that peach trees live only from nine to twelve years even when properly cared for and protected.²

Of fruit diseases in the neighborhood of Delaware City in 1856, according to John C. Clark,³ "the blight or yellows in peaches is the most troublesome. Excepting this the above-named fruits are but little liable to disease."

"By 1855," says Dr. Dunlap, of Delaware City, "the yellows had taken possession of nearly all the orchards, and peach culture in this section was at an end." Many of the peach growers had, however, begun again on farms in Kent and Cecil, Maryland.⁴

In 1858, one of the editors of *The Country Gentleman* visited New Castle County and commented on peach growing as follows:⁵

We came to the residence of William Reybold, Esq. [son of Maj. Phillip Reybold], not far from Delaware City, who here occupies a fine estate of 460 acres, and has another farm within a short distance of 375 in addition. His orchards formerly sent five, six, and seven thousand baskets of peaches a night to New York for a period of about six weeks, employing several steam-boats for the purpose; and 70 acres—30 of them in three-year old and 40 in four-year old trees—one year netted their owner the handsome figure of \$12,000. But the days of the peach in all these coasts seem to be numbered; their glory and profit have departed. Some mysterious disease [yellows] has for five years past [since 1853 or 1854 according to this] kept them declining, and for the last two they have not paid. The ax has been laid at the root of their once fruitful and money-bringing boughs, and trunk, and branch, and twig, they are now being cut down and hewed to pieces for fire-wood.

¹ *The Cultivation of the Peach and Pear on the Delaware and Chesapeake Peninsula*, by John J. Black, M. D., Wilmington, Del., 1886, p. 81.

² *The Southern Planter*, reprinted in *The Horticulturist*, Albany, N. Y., 1846, pp. 36 and 37.

³ Quoted by L. P. Bush, chairman of fruit committee for Delaware. *Proceedings of the Am. Pom. Soc.*, 1856, p. 99.

⁴ Letter of January 17, 1888.

⁵ *The Country Gentleman*, Albany, N. Y., July 22, 1858, p. 42.

Is it not to the reflective pomologist a melancholy fate? to the lover of fruit a sad misfortune? Newly planted orchards on land where a peach tree never grew seem to fare no better; they sicken, lose all their thrift, and apparently die by inches.

The writer knew the symptoms of yellows, but on the day of his visit it was raining so that apparently he did not enter the orchards. On page 286 of the same volume, in answer to a correspondent, who asks if this wide-spread peach disease is yellows, the reply is:

The disease in Delaware may be yellows, yet, as we do not know all the symptoms as developed there, we can not speak positively.

Fortunately we are now able to speak without reservation. The disease was yellows, and it very soon put an end to peach growing in the upper part of New Castle County.

In 1862, at Port Penn, a few miles south of Delaware City, all the orchards were out, and the young trees were not yet in bearing.¹ These young orchards suffered the fate of the older ones, and there are now no orchards in that vicinity.

In 1870 [writes Dr. Dunlap] there were very few if any peach trees nearer us than Mount Pleasant on the Delaware Railroad; the mass of the orchards in this county was between Middletown and Smyrna.²

The present condition is substantially what it was in 1870. Dr. Dunlap writes:³

Many of our farmers after a lapse of twenty years have set out new orchards, which seem to thrive and do well until they are between two and four years old, when the yellows invariably makes its appearance, and the trees soon die. The most of the first orchards in this section continued in fair to good bearing for a period of from twenty to twenty-five years, and some even longer; whereas trees recently planted seldom live more than from three to five years, though planted in ground never occupied by a peach orchard.

My own observations in 1888 in the vicinity of Townsend, Middletown, McDonough, and Odessa confirm this statement. The young orchards very soon premature their fruit and die, even on land never before set to peach trees.

With the decadence of peach growing in the vicinity of Delaware City there was a large increase of orchards in the southern part of the county, with a corresponding rise in land values. The first Odessa orchards were planted in 1840. Many orchards were set towards the end of the fifth and in the early part of the sixth decade. In 1866 there were hundreds of acres of healthy peach orchards, in the vicinity of Odessa, McDonough, and Middletown, and real estate changed hands at fabulous prices. In the spring of that year, near Middletown, one man offered his peach orchard for \$1,500; afterwards refused \$5,000 for it, and finally sold his crop for \$2 a basket, clearing, \$9,000.⁴

In 1867, according to Henry T. Williams, the peach shipments from Delaware by railroad were 1,108,000 baskets, and by water 750,000,

¹ E. B. Pennington, letter of January 25, 1888.

² Letter of March 19, 1888.

³ Letter of January 17, 1888.

⁴ *The Cultivator and Country Gentleman*, Albany, N. Y., March, 1867, p. 209.

making a total of 1,858,000.¹ A very considerable part of this total, probably over one-half, came from southern New Castle.

Mr. E. C. Fennimore, who had a landing on Delaware River, was especially successful. A McDonough correspondent of *The Cultivator and Country Gentleman*² says that Mr. Fennimore's peach orchard "has not failed once since it came into bearing seven years ago with 10,000 trees; it now numbers 9,000."³ The surrounding orchards, however, never did so well.

The conditions of peach growing twenty-eight years ago in the central and southern parts of New Castle County are very pleasantly set forth in a popular article by William C. Lodge.⁴ The following paragraphs afford a striking contrast to present conditions, and are not greatly exaggerated, judging by statements I have received from many eye-witnesses, and by what I have myself seen more recently in Kent County:

Proceeding to Middletown [from Delaware City], we pass through a continuous orchard or a succession of orchards that seem to be one vast whole, the trees everywhere bending or broken with their loads of high-colored fruit. Middletown is on the Delaware Railroad, and is the central station in New Castle County. On the track there is a train of 15 cars waiting for the day's pickings.⁵ Each car carries about 500 baskets, and although early in the morning, the peach teams are already coming in from all directions. * * *

From Middletown to Townsend [4 or 5 miles south], where another peach-train is waiting. The whole available country is planted with peach trees.⁶ The ordinary farm crops appear to be neglected, while the labor is wholly devoted to gathering and marketing the fruit. In the alluvial table lands of this neighborhood the peach tree finds all the elements for the production of fruit. It is new soil, and the trees are exempt from disease and from such insects as render peach growing precarious in other sections equally favored by climate.

The orchardist is generally satisfied with a yield of three or four baskets of marketable fruit from each tree; but here the average is from seven to eight baskets from mature trees, and many orchards give even more.

* * * * *

The orchards increase in size as we proceed southward. Here [between Middletown and Townsend, apparently] they are composed of from ten thousand to one hundred thousand trees each.

By a slight detour [north] we strike the Delaware and Chesapeake Canal, the northern outlet for the products of the eastern shore counties of Maryland, as well as for the farms along its course through Delaware. The plantations along the canal and those extending several tiers back, are devoted to peaches. There is a landing on every farm, besides the public landings where the roads cross the canal. The boats that carry the fruit are drawn by four horses or mules and have capacities for from five to seven thousand baskets.

* * * * *

¹ *The Cultivator and Country Gentleman*, Albany, N. Y., July, 1868, p. 14.

² *Ibid.*, January, 1869, p. 79.

³ Yellows first appeared in this orchard in 1865 or 1866, in spots, and gradually became worse. In 1869 Mr. Fennimore had about 4,000 baskets of premature peaches out of 34,000. Many trees were dug out, early in the seventies, on account of yellows, and the whole orchard was removed in 1874.

⁴ *Peach Culture in Delaware*, *Harper's Magazine*, N. Y., 1870, pp. 511-518.

⁵ In 1875, 56 car-loads of peaches were shipped from Middletown in one day.

For condition of peach orchards about Townsend, Del., in 1888, see Photo. XII.

About 25,000 baskets are daily carried by the canal-boats in the flush of the season.

Along the tow-path, in our drive of half a dozen miles, we notice that the landings are covered with peaches and the attendant teams, with the parties waiting to put the fruit on board. This is the universal harvest, and brings money to the purse of every one willing to work, plenty to every home, and good cheer to every board. To the family of the planter it means many luxuries in the shape of pianos, new carriages, and perhaps an additional farm or two.

In 1870, when there were no longer any peaches at Delaware City, single growers in the vicinity of Middletown numbered their orchards by hundreds of acres.¹ Ex-Governor John P. Cochran, who now has no peach trees, writes that at this time he had over 80,000.² He saw the trouble coming and abandoned the business.

In August, 1871, Charles Downing, George Thurbur, P. T. Quinn, William Parry, Randolph Peters, and Howard M. Jenkins, of the Delaware Tribune, visited this region and examined the peach orchards.³ They found J. B. Fennimore to be one of the largest growers. At Middletown were many large peach farms; that of the late Cantwell Clark contained 280 acres of peach orchard; that of J. T. Ellison, 100 acres; the four farms of B. T. Biggs, about 350 acres, *i. e.*, 35,000 trees. "The orchards near Middletown are in fine condition, the land being heavier and trees more productive than at points farther south." This condition of things appears to have extended to the extreme southern end of the county, for mention is made of the peach farm of Samuel Townsend, near Smyrna, containing 400 acres, from which he was then shipping three car-loads of fruit per day.

The transcript from Mr. Fennimore's note-book, 1861-'74, given later, also shows very clearly how free from disease and how profitable were the peach orchards of this region during that decade. Middletown was then the great shipping center of the peach country. Buyers flocked thither from all quarters and the peach-growers became wealthy, adding orchard to orchard and farm to farm. In 1872 the shipments by car from this place were 450,000 baskets; in 1873 they were 300,000 baskets. In 1873 Mr. Seerick Shalleross alone shipped to New York 125,000 baskets of fruit from an orchard said to be the largest in the world. This covered over 1,000 acres, contained more than 100,000 trees, and was valued at \$150,000.⁴ Other growers had nearly as many trees.

Peach culture reached its maximum in this part of New Castle about 1875, since which time it has steadily declined. In 1888, I found no orchards of any consequence between Middletown and McDonough, in the fine country formerly so thickly planted. Large farms once almost entirely covered by orchards now contain not a tree. Hon. John J.

¹ William Parry, in *Proc. Pa. Fruit Growers' Soc.*, 1871, p. 47.

² Letter of March 29, 1888.

³ Horticulture on the Delaware Peninsula. *The Horticulturist*, N.Y., 1871, pp. 306-308.

⁴ *The Horticulturist*, N. Y., 1874, p. 287.

Black, of New Castle, and E. R. Cochran, of Middletown, agree in estimating the total number of peach trees in New Castle in 1870 at 1,000,000 and in 1875 at 1,750,000.¹ H. H. Appleton, of Odessa, also estimates the number of bearing trees in 1870 at 1,000,000, equal to 10,000 acres.² Governor B. T. Biggs "would suppose we had in New Castle County in 1870 about 500,000 peach trees. Most of the orchards were in our county, between Duck Creek Hundred and Middletown."³

As at Delaware City, so at Middletown, the "glory and profit" of peach growing have departed, and under the same blighting influence. The history of the first appearance of yellows, of its progress, and of the gradual disappearance of the orchards, is not essentially different from that already given in some detail for Delaware City and for Saint Joseph, Mich. There was first a more or less general complaint of great losses from prematurely ripened fruit. This was followed by the appearance of disease in the tree itself. The growers sought to explain the "premature" in every way but the right one; they hoped it would disappear next year, and could not very generally bring themselves to accept the unwelcome truth. Some persons dug out the affected orchards at once, believing the disease to be communicable; but most only later when it had become evident that the unfruitful, moribund trees were valuable only for fuel.

Probably at no time since 1850 was yellows entirely absent from the orchards in this section, and after 1856 it seems to have done considerable injury.⁴ But this first epiphytic passed off, and, as we have seen, peaches were grown very successfully until the seventies, when there appeared a second and more destructive outbreak of the disease.

Yellows was at its height in the southern half of this county in 1875, and comparatively few orchards were planted after this date. Of those who persisted in planting, a majority, I am told, lost their trees by yellows within the first six years. The orchards seemed to grow thrifitly and do well for three or four years, and then rapidly declined.

Middletown is no longer the center of the peach region, and comparatively few peaches are shipped from this point, or, indeed, from any part of New Castle. The total baskets shipped from this station in 1875 were 632,427; in 1888, a year of similar abundance, 125,150. The peach center is now below Dover, and the evidence is very strong that it is moving southward. Last year in the vicinity of Middletown, and again this year, I saw comparatively few orchards, and yellows was present in all of these. I heard a great deal about the losses caused by this disease in years past, and saw abundant evidence of its destructive work in the way of stumps and remnants of orchards (see photo XII). This year I saw peach yellows in many other parts of

¹ Letter of March 31, 1888.

² Letter of April 3, 1888.

³ Letter of March 27, 1888.

⁴ H. H. Appleton, Odessa, letter of April 3, 1888; and James Hoffecker, Smyrna, conversation of October 8, 1887.

New Castle County. There are very few old orchards, and the younger ones just coming into bearing are nearly all so badly diseased that they will be worthless in the course of three or four years.

The peach acreage of New Castle County in 1888, as compared with that in 1875, shows a great falling off. Everybody admits this. There are no official statistics, but the most reliable estimates place the number of trees in 1875 at about 1,750,000, *i. e.*, about 17,000 acres,¹ most of which were in the southern one-third of the county. The present extent of peach orchard is variously estimated. It is probably about one-sixth what it formerly was, but is not one-tenth—possibly not one-twentieth—of what it would have been but for the yellows.

In 1860, roughly speaking, the orchard products of New Castle County were worth twice those of Kent County and five times those of Sussex County. In 1870 New Castle still led; Kent produced about five-sixths as much, and Sussex one-sixth. In 1880, as compared with 1870, New Castle had fallen off five-sixths, Kent had remained about stationary, and Sussex had doubled.² During all this period the greater part of the receipts from orchard products in each of the counties was for peaches.

Kent and Susser.—The growing of budded peach trees in Kent County began somewhat earlier than in New Castle. At Frederica, Jehu Reed planted an orchard of several hundred Red Cheek Melocotons in 1829, and within two or three years set other budded sorts to the number of 10,000, but others did not follow his example until considerably later. However, by the year 1860, there were many market orchards, especially in the upper half of the county. In lower Kent and in Sussex large commercial orchards did not become numerous until a decade later, and in some parts of Sussex they are of still more recent date, a very large number of trees having been set since 1880.

In 1868, according to Henry T. Williams, orchards in Kent and Sussex ranged from 5,000 to 20,000 trees, and in 1867 one man in Sussex put out 60,000. Mr. Williams also mentions having seen at this time near Dover a bearing orchard of 70 acres.³

In the article already quoted,⁴ William C. Lodge gives a graphic picture of the extent of the peach industry in 1870 in the upper part of Kent:

Kenton, in Kent County [10 miles northwest of Dover and 5 miles from the New Castle line], is the next point of particular interest, as we are invited to inspect the fine orchard of Mr. Gercker in that vicinity. We drive through Smyrna, renowned for its peaches rather than its figs. * * *

We pass orchard after orchard walled in by the impenetrable osage-orange hedge

¹ The number of acres of peaches in New Castle in 1879, according to unpublished statistics of the U. S. Census, furnished by the Department of the Interior, was 11,600.

² Eighth Census U. S., Vol. on Agri., p. 16; Ninth Census U. S., vol. 3, p. 114; and Tenth Census U. S., vol. 3, p. 261.

³ Loc. cit.

⁴ Loc. cit.

that here grows luxuriantly. The country is nearly level and the roads so straight that we look before us away to where the lines of green converge to a point. * * *

But here is Gercker's; and the first sight shows that it is a model peach farm. We take a bird's-eye view of the thousand acres and note the order and neatness of the plantation, laid out in square fields of 100 acres each. The buildings are located in the central part of the only field not planted with peach trees. A silver thread of water winds about the southern boundary, towards which the ground inclines. All other parts appear to be as level as a floor. * * *

The trees are planted in parallel rows about 8 spaces apart, and from our perch upon the top of a high gate-post we look down upon a section of the orchard in full bearing, extending from near the house to the distance of over a mile. * * *

In the early morning * * * we start for Dover, the State capital and the center of the finest peach district in the world.

* * * * *

At Dover is a large distillery and three canning establishments, capable of preparing 25,000 cans of peaches a day. * * *

From Dover the railroad carries a daily average of 10,000 baskets, while three large steamers ply between its port at Mahon and New York City during the season and are unequal to the freight. To-day hundreds of baskets are left on the wharf to perish or to be sold to distillers at a very low price. Yet the loaded wagons still come to the landing, and a mile away we can see clouds of dust indicating the speed by which the driver hopes to get on board his last load.

Ten years later peach growing was a great industry around Smyrna, Dover, Lebanon, Camden, Canterbury, Frederica, and in many other parts of the county. The United States Census of 1880 determined the number of acres of peach orchards in Kent County in 1879 to be 19,879, containing 1,837,211 bearing trees.² Many thousand trees have been planted in Kent since that date, and the most reliable estimates place the present number of acres of peach orchard of all ages at 40,000. There is scarcely a farm without its peach orchard. Many of these orchards contain from 30 to 50 acres, and not a few are still larger. Some single farms contain more than 10,000 peach trees, and where one man owns several farms he frequently controls from 500 to 1,000 acres of peach orchard.

The growing of budded fruit began in Sussex considerably later. In 1860 the total orchard products given in the United States Census reached a value of only \$13,189; in 1870 the value is said to be \$103,192; and in 1880, \$243,132. The United States Census of 1880 determined the acres of peach orchard to be 12,977, containing 1,230,134 bearing trees.³

¹ Mr. John Taylor, of Dover, tenant on this farm from 1869 to 1872, informs me that during the entire three years he never gathered a single basket of premature fruit, and that on the whole farm he then knew of only one diseased tree. This stood in an apple orchard near the lane and bore premature peaches. The whole farm was then set in peach orchard. In 1869 this farm produced 152 (?) car-loads of peaches; i. e., 51,000 baskets. In 1870 it produced 16,300 baskets, netting \$11,100. (Conversation of July 6, 1888.) Yellows is now prevalent throughout that section and many orchards are being ruined.

² From unpublished data of the Tenth Census, furnished by the Department of the Interior, Washington, D. C.

³ From unpublished data of the Tenth Census, furnished by the Department of the Interior, Washington, D. C.

Since 1879 many peach-growers from the upper part of the State have gone down into Sussex, and numerous large orchards have been planted. The most reliable estimates place the number of acres of peach orchard now set in Sussex at upwards of 20,000. In 1887 the best peaches came from Sussex and southern Kent, and the same was true in 1888.

The topography of Kent is quite monotonous. The land is flat and but little raised above the sea, so that the bay front includes very extensive marshes. There are no hills, save by courtesy. Square miles of the country are almost as level as a floor, and nowhere did I observe a variation in level of more than 100 feet, and rarely so much as that. The land was formerly covered with a good growth of oak, tulip tree, chestnut, walnut, sassafras, sweet gum, and other deciduous trees; but the forests have given place to farms. These farms are generally larger than those of New York and the Eastern States, although not more carefully tilled. The soil is fertile, varying from a comparatively stiff loam to light sand. The greater portion of it is a mellow loam, the subsoil being usually a yellow, white, or reddish clay. In the extremely flat land southwest of Felton the soil has a peculiar ash-color. East of Felton and north of Milford I saw some pine timber of small size, second growth perhaps, and there found patches of quite sandy soil, which did not appear to be very fertile.

With the soil and topography of Sussex I am not so well acquainted. It is a nearly level county, of lighter soil than Kent, a very much larger portion having been or being now covered with pine forest or gum-tree swamps. There are in the county, it is said, more than one hundred mills for the manufacture of lumber. In the west part I saw much sandy scrub-pine land of small value for agriculture.

It is impossible to determine when yellows first appeared in Kent County. Dr. Henry Ridgely, who is an extensive grower and familiar with the disease, informs me that he saw it near Dover over thirty years ago, and John S. Jester states that it appeared in his father's orchard, near Harrington, more than thirty years ago, and killed the trees in course of a few years with precisely the same symptoms that the disease now manifests. Moreover, Hon. George P. Fisher, writing from Dover in 1852,¹ describes peach yellows so that there can be no doubt of what he is speaking, and implies that it is present in Kent County. It was not so common as to attract much attention when the diseased trees were dug out and burned. He advised prompt removal and burning; thought the disease could be prevented, but not cured. From these statements it is apparent that yellows was present in Kent at about the time the orchards were being destroyed in the vicinity of Delaware City.

Two decades later, when the orchards about Middletown were destroyed, the disease was at Clayton, in an orchard owned by Alfred Hudson, and at Cowgill's Corners, 4 miles east of Dover, in an old orchard owned by Dr. Henry Ridgely. Jehu M. Reed also informs me

¹ Report of Commissioner of Patents (Agriculture), 1852, pp. 112, 113.

that he saw it for the first time in Kent County about ten years ago (1878) in Mr. Bancroft's orchard, near Camden. At first only one tree was diseased. Jacob Brown also says it was present in one of his orchards south of Dover in 1875. There has probably been no time since 1850 when the disease was not present in some part of Kent County. Nevertheless until recently the orchards as a whole remained free from its ravages. The progressive increase in number and size of plantations; the absence of general complaint, such as now exists; and the large number of old and healthy or but recently diseased orchards in all parts of the county is sufficient proof of this. There are also some interesting specific statements. In 1869 Dr. G. Emerson, formerly of Dover, refers to the remarkably long life of the Delaware peach orchards;¹ so in 1870 William C. Lodge, already quoted;² so in 1873 Alex. Pullen, already quoted;³ so in 1886 P. M. Augur;⁴ so C. P. Hovey and others. D. S. Myer, writing from Bridgeville, Sussex County, in 1880,⁵ and W. P. Corsa (?), from Milford, in Kent, in 1883,⁶ state that yellows had not appeared at either place, and the internal evidence of their writing, as well as the present condition of the orchards, bears them out. To these published statements might be added a large amount of oral testimony from Delaware growers.

I have also received a letter from Jehu M. Reed, of Frederica, stating that yellows never appeared on his home farm until about three years ago, although orchards to the extent of ten thousand trees have been cultivated on this farm nearly all the time for fifty-nine years; when one orchard was wearing out, another of about the same size being set on a different part of the farm.⁷

It is thus sufficiently apparent that, while the disease was certainly present in Kent at an early date, it did not occur in many orchards or do very serious injury. Why did it not spread from these early centers? The explanations which have been suggested will be discussed later under soil exhaustion, etc.

In 1887 I spent the last part of August, all of September, and the first part of October in Kent County. My headquarters were at Clayton, Dover, and Felton, but by excursions from these points I was able to examine the greater part of the county and to obtain a very full knowledge not only of the extent and importance of the peach industry, but also of the present distribution of peach yellows, which in some respects is very interesting. I found the disease almost wherever I went. There was great complaint and much gloomy foreboding. The disease

¹ *Proceedings of the American Pomological Society*, 1869, p. 153.

² *Loc. cit.*

³ *The Maryland Farmer*, 1873, p. 77.

⁴ *Twentieth Annual Report of the Connecticut Board of Agriculture*, p. 345.

⁵ *The Gardeners' Monthly*, Philadelphia, p. 206.

⁶ *The Milford Chronicle*, October, 1883.

⁷ Letter of April 16, 1888.

was most prevalent from Smyrna to Wyoming and east to the bay, but even here I was repeatedly assured that the trouble had not been serious until the last two years. During the summers of 1886 and 1887 the disease was observed to spread with alarming rapidity. "It spread like fire", to use a common but somewhat exaggerated expression. I made more or less careful examinations in seventy-five orchards, of all ages, on all kinds of soil, and embracing a total of several thousand acres. In suitable orchards I spent from one to several days and made the examination as exhaustive as possible. It was my special good fortune to see the disease in all stages during the growing season, and to secure the cordial sympathy and co-operation of a great many peach-growers, without which the inquiry would have been much less satisfactory.

Principally from my field-notes I summarize as follows: About Clayton and Smyrna yellows is in all or nearly all the bearing orchards. I do not recall any that were entirely free, and some are so badly diseased as to be of no value save for fire-wood. The orchards are numerous. Almost every farm has from one to a half dozen. On some farms as many as 100 or 200 acres are devoted to peach orchard. The trees are of all ages, from those set in 1887 to those over twenty years old. From evidence obtained in the orchards I judged that yellows had been present in some of them four or five years, while in others it certainly first appeared in 1887. This judgment was afterwards confirmed by the owners. The disease occurs in bearing trees of all ages.

At Leipsic, southeast of Clayton, I saw many diseased trees and some fine young bearing orchards of large size which have been almost entirely ruined within the last two or three years.

At Dover a number of orchards are entirely ruined, and many others are in a fair way to be at an early date. In some of these the disease has been present for several years, but in a majority it first appeared in 1886 or 1887. Many orchards now affected were entirely free from it until 1887. Here also I found the disease in bearing trees of all ages.

Speaking for all upper Kent, the north one-third, it may be said that the disease was in four-fifths of the orchards and in many of them to an alarming extent. I do not recall a single orchard over three years of age in which I did not find more or less affected trees. I heard of orchards free from it and I do not doubt that some such were to be found. This part of Kent produced few peaches in 1887.

In middle Kent the disease was scarcely less prevalent. In this part of the county there was a considerable crop of peaches, and I heard great complaint, especially about Lebanon, Canterbury, Camden, Wyoming, and Magnolia, of premature fruit. I also saw a great deal of this sort of fruit. In some instances from one-third to one-half the crop ripened prematurely, with great loss. In my judgment the disease was present in three-fourths of the bearing orchards. In many it first appeared in 1887, and in comparatively few could I discover, either by ex-

amination or by inquiry, that it had existed for any great length of time. Nearly all the trees indicated recent disease. However, in one orchard at Magnolia, which I did not examine, the disease had been present for a number of years, according to the owner's statement. I heard similar statements respecting one or two other orchards, but owing to lack of time did not verify them.

In southern Kent, the lower one-third, the disease was less frequent. Many farmers, especially those living west and southwest of Felton, had never seen peach yellows, and were entirely ignorant of its effects. Here I saw the disease in a number of orchards, but in no case were there many trees affected, nor was there any evidence of its having been present previous to 1887. In many orchards which I could not examine I was told by the owners that the disease had not appeared; and in quite a number of others I know from personal inspection that the disease was not present in 1887. During my stay at Felton peaches were being brought in from this region for shipment, and on several occasions I examined many loads without finding any "prematures." Mr. William V. Smith and other peach-buyers then at Felton also told me that comparatively few premature peaches had been brought in by the farmers at any time during the season.

East of Felton towards Frederica, and east, southeast, and south of that place, the disease was in at least one-half the bearing orchards, but in a majority of these orchards only a few trees were yet affected. Most of these trees became diseased during the year 1887. However, east and southeast of Felton there was abundant evidence in three orchards that yellows had been present several years, probably four or five, and statements made independently by a half-dozen persons confirmed this inference.

I saw well-marked cases of the disease as far south as Milford, both in the village and in orchards north and west, and from reliable men had account of its appearance in orchards which I did not visit. It was said on good authority to be in one-half the orchards in that region; but, from what I saw and heard, I have reason to believe that until 1886 this part of Delaware was almost entirely free from yellows—perhaps entirely free. I saw the disease in bearing trees of all ages; but, with one or two exceptions, I did not see many diseased trees in any one orchard.

The conditions in 1888, in this part of Kent County, did not seem to be materially changed. The disease appeared, however, in some orchards previously free from it, and new cases developed in the orchards already affected.

As a whole, the trees in southern Kent are still healthy, while in the north one-third of the county the reverse of this statement is true. In the center and south part of the county I saw many orchards between twenty and thirty years of age, some further account of which will be given later under "climatic conditions." The greater number of the trees in these old orchards are still thrifty and in good bearing condi-

tion. Both in 1887 and in 1888 many of them were bent to the ground under their burden of healthy peaches.

I did not visit Sussex County in 1887, but spent some days at Seaford in 1888. I am inclined to think that yellows has not yet appeared in that county, at least not to any extent, unless it be near Milford. The evidence on which I base this inference is fivefold:

(1) The fact that yellows prevailed first in New Castle County and later in Kent, and that as we proceed southward through Kent the disease becomes less and less frequent.

(2) The fact that the disease does not occur, at least to any great extent, in the Maryland counties to the west and the Maryland and Virginia counties to the south of Sussex, and that on the whole west side of the Peninsula in Maryland the disease first appeared in the north, and, as in Delaware, shows a general tendency to move slowly from north to south.

(3) The entire absence on the part of the growers and buyers of any complaint about prematurely ripening peaches. There has certainly been no premature fruit of any amount in any part of the county, and growers have had no experience with the disease, most of them never having seen a case.

(4) The explicit denial of its presence by representative growers in various parts of the county—men of intelligence and character, who have seen the disease in Kent and New Castle, and would know it at sight.¹

(5) The fact that in August, 1888, I could not find any clearly defined cases of the disease at Seaford or Laurel, although I inspected about thirty orchards and talked with many growers. The most I could discover was a few suspicious trees at Seaford in two or three young orchards, recently imported from New Jersey.

Nevertheless, the disease may be present to a limited extent in various parts of Sussex; and, judging from the nature of its movement on the Peninsula, it is only a matter of time when there also it will become a serious hindrance to successful peach growing, unless some method can be devised for keeping it in check.

Maryland.—What has been said relative to early peach growing in Maryland need not be repeated here.

What has been said of Delaware applies equally to the peninsular part of Maryland. The entire Chesapeake and Delaware peninsula, surrounded by Delaware Bay, Chesapeake Bay, and the Atlantic, enjoys a moist, equable, almost insular climate, very favorable to the growth and perfection of the peach. There is no locality on the globe where this tree is grown more extensively, or where, upon the whole, it has been more productive or more perfectly at home.

My own inquiries relate specially to the Peninsula, and in considering the recent progress of peach growing and the increase of yellows in

¹J. H. Myer, of Bridgeville; E. L. Martin, of Seaford; Harbeson Hickman, of Lewes; Hon. — Bacon, of Laurel; etc.

Maryland, I shall first consider this region beginning with the more northern counties.

Cecil County is the most northern, bounded on the north by Pennsylvania, on the east by upper Delaware, on the south by Kent County, from which it is separated by Sassafras River, and on the west by Chesapeake Bay and Susquehanna River, which separate it from Harford County.

In Cecil County the first budded orchard of any consequence was set in 1836,¹ on the "Cassiday" or "Peach Blossom" farm, in Sassafras Neck on the river six miles southwest of Cecilton. The "Cassiday" farm soon became famous through all that region both for the quantity and the quality of its peaches; and for many years this reputation was more than sustained. In 1856, this peach farm, containing 663 acres, rented for \$6,600; and in the winter of 1856-'57 it was sold to Anthony Reybold, of Delaware, for \$51.50 per acre.² In September of the next year, we are told, Mr. Reybold expected to realize "over \$30,000" from his orchards on the Cassiday peach farm.³

By this time many others had begun to plant orchards and the whole Sassafras River region was regarded as a very favorable locality for peach culture. Peaches would grow there, if not any longer at Delaware City.

In 1862, a Cecilton correspondent of *The Country Gentleman*⁴ writes in the following vein:

The peach crop is fast becoming the moneyed one; hardly a farm is without its thousand or more trees. The Cassiday farm, now Reybold's, has 400 acres in peaches. There are several other orchards nearly as large.

In 1874, Sassafras Neck was still a famous peach region, the most important in the county.⁵ This relative importance it has retained up to the present time. Peach-growing in Cecil appears to have culminated some time between 1874 and 1887, and to be now on the decline; but although I visited the county in 1888 I have not enough data to discuss the matter satisfactorily.

Of the present extent of peach-growing George Biddle, of Cecilton, vice-president of the Peninsula Horticultural Society for Cecil County, writes as follows:⁶

Cecil County is divided into nine election districts, beginning in the south on the Sassafras River and running toward the Pennsylvania line and thence westward to the Susquehanna. This, the first district, has about a half million peach trees. Scarcely a farm that has not an orchard. The second, Chesapeake district, has perhaps half as many; and the third, Elkton, a few about Iron Hill. The remainder of the county has scarcely any, none for market.⁷

¹ George Biddle, letter of February 23, 1858.

² *The American Farmer*, Baltimore, Md., 1857, p. 223.

³ *Ibid.*, 1858, p. 94.

⁴ *The Country Gentleman*, Albany, N. Y., 1862, p. 235.

⁵ *The American Farmer*, Baltimore, 1874, p. 179.

⁶ Letter of February 23, 1888.

⁷ One sees no orchards of any consequence in passing through Cecil along the line of the Philadelphia, Wilmington and Baltimore Railroad from Elkton to Havre de Grace, or in the fine country on the stage line between Middletown and Cecilton.

Yellows has undoubtedly been present in some parts of the county for many years. G. Morgan Eldridge thinks he saw one or two cases on his home farm, near Cecilton, as early as 1844 or 1845. It was in the orchards of Harford County in 1861, 1862, and 1863,¹ and most likely at this time, if not earlier in those of Cecil. Dr. W. S. Maxwell states that premature peaches have been coming down from Cecil County, on the Baltimore boats, since as early as 1874, and by the year 1880 as many as one-half of some shipments were of this sort.

Mr. Biddle says :

I have been engaged in growing peaches since 1855. During that time there has been some yellows. As to the cause or cure I know nothing. A few years since it began in the orchards of my neighbor, Mr. Hurlock; the next spring [1884] it crossed the road to one of mine, and spread like fire from row to row, so that I cut it down in the summer. This is my only experience with it.²

Last year I was told by several peach-growers living on the south bank of Sassafras River, that yellows had destroyed whole orchards in Cecil during the past few years, but can not vouch for the entire accuracy of these statements. It is certain, however, that the epiphytotic of 1886, 1887, and 1888, affected many orchards in this county.

Mr. William V. Smith, of Philadelphia, who has bought peaches for several years in Maryland and Delaware and is familiar with the whole region, told me in August, 1887, at Felton, Del., that he saw a great many premature peaches in Cecil County in 1886. Dr. Dunlap also speaks of the disease as having been prevalent in Kent and Cecil since "about 1886;" and Wesley Webb states that it is a serious obstacle to peach-growing at Iron Hill in Elkton.³ My own observations in 1888 also convinced me that yellows is as prevalent on the north as on the south side of Sassafras River. I saw the disease in almost every bearing orchard, and often in many trees.

Of Kent and Queen Anne, lying south of Cecil, I can speak more confidently, having examined many orchards in various parts of these two counties in July and August, 1887.

A preliminary account of the soil and topography of this part of Maryland is necessary to a full understanding of the situation. The land of Kent and Queen Anne is somewhat rolling. The whole Chesapeake side of the Peninsula appears to be higher than the Delaware side, and in places along the bay the land is somewhat hilly, not, however, in a New York or a New England sense of the term. Along the upper part of the bay, at least, there are comparatively few marshes. The first glimpse one gets of the "East Shore," sailing over from Baltimore of a July day, are peculiarly charming. One sees stretching away for miles a succession of low green bluffs and level tracts, 20 to 50 feet or more above the bay, dotted with orchards and farm-houses, and in-

¹ *The Country Gentleman*, 1862, p. 270, and 1863, p. 209.

² *Loc. cit.*

³ *Transactions of the Peninsula Horticultural Society*. Dover, Del., 1888, p. 45.

terspersed with groups of low conifers and small bodies of deciduous forest.

Nor does further acquaintance disenchant one. I landed at Centerville; saw the country there; at Queenstown; in Spaniards' Neck on the east shore of Chester River; in Quaker Neck on the west shore; at Price's Station; at Church Hill; at Chestertown; at Still Pond; at the mouth of the Sassafras River; at Locust Grove, and in various other parts of both counties. There is some poor land, but the greater part of the country is excellent farming land, free from stones and marshes and under a good state of cultivation. The farms are larger than in the north and probably not as fertile as they once were. Originally a good portion of this region must have been a very garden of fertility. Stock-raising is not extensive. Wheat and corn of excellent quality are staple crops. In some places wheat, which was then being thrashed, yielded from 25 to 30 bushels per acre, but the average yield is less, probably considerably under 20 bushels. Commercial fertilizers are commonly used, especially for wheat.

The soil varies from a rather stiff clay loam to a light sand. As a whole it is loam, with clay predominating in Kent and sand in Queen Anne. Farther south, in Talbot and Caroline, I am told that the soil is sandy and less productive. The subsoil in Kent is red or yellow clay; in places white clay. Land with red-clay or yellow-clay subsoil is usually selected for peaches. The white-oak land generally has a white-clay subsoil and is not considered so desirable. Chestnut and sassafras land produce the finest orchards and the best peaches. The original timber, now largely gone, was walnut, chestnut, oak (red, black, and white), sweet and sour gum, sassafras, tulip tree, locust, and other deciduous trees. I saw many red cedars, but do not remember to have seen any pine in upper Kent. In Queen Anne and lower Kent there are some pine trees of two species, *P. inops* and *P. Teda*. From what I saw I have no hesitation in saying that both Kent and Queen Anne are prosperous and fertile counties.

Peach growing is an important industry in both and the leading one of many sections. The two counties together produce more peaches than all the rest of the East Shore and nearly one-half as many as all the rest of Maryland. The fame of the East Shore peaches is almost co-extensive with that of Maryland itself. Kent is the older county and leads in the production of this fruit.

The first Kentish orchards of budded fruit were set about 1839 or 1840; some along Chester River, others along the Sassafras, others on the Bay shore. Between 1840 and 1850 many small orchards were planted.

Col. Edward Wilkins set his first large orchard—200 acres—near Chestertown in 1856, and continued to be a large grower for twenty years. Other large orchards were planted about 1856. In 1871 Colonel Wilkins had 1,350 acres in peach orchard, *i. e.*, 136,000 trees.¹

¹ *The Horticulturist*, New York, 1871, pp. 306-308.

In *The American Farmer*¹ for 1872 is an interesting account of a visit to "a Maryland peach orchard," made by the editor in September of that year. This orchard belonged to Col. Ed. Wilkins, of "Riverside," who was then believed to be the largest peach-grower in the world. On his home farm were about 25,000 bearing trees, an old orchard, of like number, having been dug out the previous winter.² This orchard, with the bearing ones on his outlying farms, brought the total up to 120,000 trees. He had also 6,000 trees which had not fruited, and proposed to plant 25,000 more in the spring of 1873.

Since the first orchards were planted peach growing in Kent has steadily increased in importance. In 1870 it was a great industry, and there were thousands of bearing trees. The United States census of 1880 determined the number of acres of peach orchard to be 13,383, containing 1,232,486 bearing trees. Since that date very many large orchards have been planted, and good judges estimate the present peach acreage of Kent County, all ages, at not less than 20,000 acres. Along the Chester River and Sassafras River and largely in the country between and along the Chesapeake southwest of the mouth of Sassafras River peach growing is the leading interest. There is scarcely a farm without its orchard, and many of them contain from 2,000 to 10,000 trees, or even more. Some of the larger growers own a number of farms, and thus control from 200 to 1,000 acres of orchard, *i. e.*, from 20,000 to 100,000 trees.

As in Delaware, the peach has been perfectly at home from the first, making a vigorous growth, yielding abundantly, and living from twenty to thirty years when not destroyed by root aphides, borers, yellows, or overbearing.

The growing of budded fruit began somewhat later in Queen Anne, but is now one of the leading industries. The total peach acreage of 1880 was 8,054 acres, containing 628,165 bearing trees,³ and the present area is at least 10,000 acres. I do not know when or where the first large commercial orchards were set, but as long ago as 1871, at Round Top, on Chester River, above Chestertown, John Harris had a bearing orchard of 1,013 acres.⁴ The next year I find reference to large orchards farther south—in Spaniards' Neck. There James Tighlman of John, had 15,000 trees and Blanchard Emory 4,000. The writer adds: "Queen Anne is not so extensively engaged in peach growing as Kent, but most of her farmers have market orchards."⁵

In 1887, I found peach orchards in Queen Anne all along Chester River and well into the center of the county. Nearly every farm has an orchard, and many are of large size; the largest I saw contains 130

¹ *The American Farmer*, Baltimore, 1872, pp. 329-331.

² Most likely the large orchard set in 1856.

³ Unpublished data of the Tenth Census of the United States.

⁴ From *Wilmington (Del.) Commercial*. Quoted in *The American Farmer*, Baltimore, 1872, p. 62.

⁵ Account of visit to Mr. Tighlman. *The American Farmer*, Baltimore, 1872, pp. 247, 248.

acres. The oldest trees now standing in the county were set about twenty-five or thirty years ago. I did not visit that part of Queen Anne lying south and east of the Centerville branch of the Philadelphia, Wilmington and Baltimore Railroad, and know nothing about the extent of the orchards in the southeastern part of the county.

When yellows first appeared in Kent I have no means of determining. James S. Harris, of Still Pond, for many years a large grower of peaches and one familiar with the symptoms of yellows, informs me that he lost 6 acres by this disease on his home farm between 1861 and 1869. Hon. Wm. T. Hepbron, of Kennedyville, also informs me that the disease has been in that vicinity from 16 to 25 years. Some whole orchards were destroyed many years ago. Across the county, at Chestertown, yellows appears to have been present in Colonel Wilkins's orchards as early as 1873, if we may judge from some statements made by him and others at that time.

In 1872, as a result of the September visit already mentioned, the editor of *The Farmer* says:¹

Except the borer the peach seems to have few enemies in Maryland. The yellows, the scourge of New Jersey, is, so far, almost unknown in Maryland.

However, in March, 1874, Colonel Wilkins contributes a curious article to *The Farmer*² on "Variation in the Season of Ripening of Peaches." He complains that a change has taken place in the time of ripening of peaches so that they now ripen at the same time. He thinks a change of quality has also taken place in some of our old and most esteemed varieties. The editors, who were evidently in the same fog, comment as follows:

The subject is one coming home to every grower of peaches for market. The fact of the gradual lessening and final disappearance of the intervals between the ripening of kinds planted to succeed each other, is one which has become apparent to all cultivators, and the evil has been very seriously felt for years, never, perhaps, having occasioned so much inconvenience and loss as in the year 1872. Then almost all differences of season appeared obliterated, and varieties whose period of ripening extended over at least three weeks' time seemed to come in together.

In the autumn of the same year³ mention is again made of the fact that Colonel Wilkins finds that varieties ripen together, when they should ripen several weeks apart. He also finds "other unfavorable symptoms in his orchards." In all probability this prematuring or ripening together was due to yellows.

William Shalleross, of Locust Grove, also informs me that as long ago as 1875, near Sassafras River, he lost 15 acres of three-year-old trees by "prematuring," and states that the remainder of the 50-acre orchard died in a few years from the same disease. Dr. W. S. Maxwell also observed the disease in this locality as long ago as 1875.

Nevertheless, it is clear that there was at this time no very general destruction of the peach orchards of Kent County. In 1886 there was,

¹ *Loc. cit.*

² *The American Farmer*, Baltimore, 1874, pp. 123-125.

³ *Loc. cit.* p. 247.

however, a great outbreak of yellows throughout all upper Kent, and this epiphytotic continued in 1887 and 1888 with increasing severity. It was certainly preceded, however, by the appearance of yellows in a number of orchards at considerable distances from each other. In fact, I am inclined to think the upper part of the county has not been wholly free from this disease since 1860.

My own studies in Kent and Queen Anne in 1887 consisted of more or less careful examination in about eighty-five orchards, and of diligent inquiry among the peach-growers, whom I found very courteous and helpful.

Landing at Centerville I examined orchards in that vicinity without finding any yellows, nor could I gather from conversation or correspondence with growers anything which led me to believe the disease was present in that vicinity. From peach-growers at Centerville I received the following written statements:

I know little, if anything, of the yellows.¹

We have never had the peach yellows among us to know it. Ours is a great peach country, and though we are largely in the business, and have been for twenty-five years, I have never seen in our county a case of yellows to know it as such.²

Orally I received much similar testimony.

The orchards lying south of Corsica River, in Corsica Neck, I did not examine, but was assured that they were entirely healthy. Many peaches are grown in that region.

From Centerville I went to Spaniards' Neck, a flat, fertile tract lying between Corsica and Chester Rivers. This region abounds in fine peach orchards. I explored the neck from one end to the other, and also the country north for some miles along Chester River, examining twelve large orchards. In none of these did I find peach yellows. Many orchards which I did not examine looked from a distance remarkably vigorous. In the whole neck I saw only three bad-looking orchards. Two were old, neglected, and full of borers, and one was apparently suffering from root aphides. Diligent inquiry in this neck failed to bring to light any evidence of the present or of the past existence of yellows. Of fruit there was very little, except in the extreme end of the neck.

Across the Chester River, in Quaker Neck, I examined a number of orchards at this time without finding any traces of yellows. Some weeks later I drove south from Chestertown and examined other orchards in the same region with a like result. One young orchard, said by the neighbors to have yellows if any in that region had it, was found to be stunted and unthrifty. The owner called the disease yellows, but I did not. The soil was a rather stiff white clay, inclined to bake. I talked with a number of intelligent growers in this region, whose orchards I did not examine; none knew of the existence of the disease in this part of Kent County. They had heard it was present farther north at Still Pond,

¹Edwin H. Brown, letter of July 13, 1887.

²Samuel T. Earle, letter of July 22, 1887.

where I afterwards saw it. If this disease occurred in Spaniards' Neck, or anywhere along Chester River, on either side, south of Chestertown, it was certainly very rare.¹

Northeast of Centerville, at Price's Station, where I examined orchards and talked with growers, the disease was unknown, but I heard of it at Sudlersville and at Crumpton, still farther north.

Near Church Hill I saw many orchards, but found the disease at one place only, in an orchard owned by Charles Weatherby. One or two small limbs on each of three large and vigorous Mountain Rose trees bore a few spotted peaches, some of which were ripe as early as July 24, *i. e.*, about three weeks in advance of the proper time. The peaches on the other limbs were green and about one half grown. There were no other indications of disease in these trees, nor in any other tree in this orchard of 25 acres, then sixteen years old, nor that I could discover in a neighboring 25-acre orchard, seven years old, although later in the season two trees were found in this orchard. The younger orchard, then full of fruit, was particularly healthy and a source of much gratification to Mr. Weatherby, who said he had never had yellows in his orchards and never knew of any in the neighborhood. Many other peach men living in this region assured me that yellows had never appeared, and some large growers of long experience, who had apparently never been very far from home, even went further and declared that there was no such thing as yellows; I was gravely assured that yellows was due to neglect and the depredations of borers and other insects, and that no man need have this disease in his peach orchards if he would only give them proper care. In one orchard I heard there was yellows, and a careful examination revealed some stunted and unthrifty trees, but no traces of this disease. The disease was present, however, that year, as I afterwards discovered, in two seedling trees in the garden of E. S. Valliant, at Church Hill, and also in two banded trees in John Evan's orchard at Rolph's Wharf.

Around Chestertown, where there are many large orchards and where I spent some time, I could find no yellows, except in an orchard belonging to Wilber Eliason. In this were sixteen diseased trees in two groups. He informed me that the yellows first appeared in 1881 in two trees only. Each year since some trees have been dug out on account of it, perhaps twenty in all. This orchard, containing about 3,000 trees, is twenty-two years old, but is still vigorous. On this farm are 140 acres of peach trees of various ages and all healthy. I saw no other cases of yellows, but some weeks later Mr. Eliason informed me that he had found and dug out a group of twelve diseased trees in a moist spot, in a large four-year-old orchard, around which we drove without entering, and which for vigor and beauty I particularly admired.

¹ In 1888 I re-examined this region very carefully, finding a few affected trees at "Riverside," 3½ miles below Chestertown, and a few also in two orchards farther down the river, in Spaniards' Neck, in Queen Anne.

Driving north from Chestertown, I began to see indications of yellows at Lynches, and from this point to Still Pond Village, and thence to Locust Grove and Sassafras River peach trees diseased by yellows became more and more frequent. In some orchards along the Sassafras one-half of the trees were affected and almost no orchards were entirely free from it. Here I also heard great complaint by many growers about loss of fruit by premature ripening, and saw many premature peaches, although it was not a prolific year. The badly diseased orchards of this region can be distinguished a mile off by the unhealthy reddish and brownish yellow color of the foliage, which is in marked contrast with the beautiful dark green foliage of orchards 10, 15, or 20 miles south.

Along the Sassafras and for several miles south the disease has certainly existed several years. The evidence of this is in the orchards themselves, and I also obtained confirmatory statements from many persons: *e. g.*—In a large old orchard owned by James Hurdd, near Locust Grove, I found about 200 diseased trees, and more than twice as many had been cut down in previous years on account of yellows. The disease first appeared in this orchard in 1884. Some miles west of Locust Grove, and north of Still Pond Village, yellows appeared in a young orchard, owned by J. Frank Wilson, in 1882, gradually involving more trees each year. North of this village, near the mouth of the Sassafras River, in a young orchard owned by Charles H. Price, yellows appeared in 1884, gradually involving more trees each year. In a neighboring old orchard, owned by Dr. W. S. Maxwell, the disease first appeared in 1883, gradually involving more and more trees, and appearing in younger orchards on the same farm in 1884, 1885, 1886, and 1887.

The distribution of peach yellows in these two counties in 1887 may be summarized as follows: It was widely and destructively prevalent along the whole length of the Sassafras River. From this point it became less and less noticeable down to Sudlersville, Church Hill, and Chestertown. South of a line drawn through Chestertown and Church Hill I could not find any traces of the disease,¹ and I was informed that it did not occur in Caroline or Somerset Counties.²

In July and August, 1888, I revisited this region and spent an entire week walking and driving in Queen Anne and southern Kent to determine, if possible, the exact southern limits of the disease. There can be no doubt that yellows is moving southward on the peninsula, or that on the southern limit of 1887 it is now in more orchards than it was then.

Around Chestertown I heard of the disease in a number of orchards said to have been free in 1887. In the orchard of Mrs. S. A. Wilkins, at "Riverside," I saw it in thirteen trees, in two widely separated groups. On the Aldridge farm near Pomona, I saw it in one tree. On

¹This line projected southeast, also very nearly indicated the southern boundary of the disease in Kent, Del., the yellows being considerably farther south on the Delaware side than on the Chesapeake side of the peninsula.

²See also statement by John Rutter, p. 35.

the Thomas place, near Fairlee, I saw it in one tree. On the farm of James L. Beck, near Tolchester, I saw it in thirty trees. With one exception all of these trees were young, and with the exception of some in the Beck orchard all became diseased in 1888. The orchards in this region are numerous and profitable. I must have seen more than one hundred, and almost all of them were very green and thrifty.

In Queen Anne County I found the disease much more prevalent than in 1887. Diseased trees were not at all difficult to find. No one knew of the disease last year, but this year the farmers were all talking about it. I saw it at Rolph's Wharf, at Church Hill, at Sudlersville, and also, to a very limited extent, in Spaniards' Neck. In the north part of the county it is in many orchards. I saw it in at least a dozen, and heard of it in others. Charles Clements, of Sudlersville, who traveled all over the north part of Queen Anne in 1888 buying peaches, told me that he found premature fruit in nearly every orchard, although, as a rule, only a few trees in an orchard were yet affected. The most I saw in any one orchard was thirty trees. This was on the farm of Findley Roberts, near Sudlersville.

The orchards of Queen Anne were green and thrifty, and at a distance gave no indication of disease.

I believe the disease does not now occur anywhere on the "East Shore" south of Centreville and Denton, although I have not traveled in any of the southern counties, but have to depend entirely on the statements of others (see Map VIII).

According to "T. E. B.," peach yellows was in orchards at Falston, in the western part of Harford County, as long ago as 1861-'62.¹ The next year the same writer says:

Peaches have generally failed in this neighborhood. [He ascribes this failure to yellows.] The yellows, as it is called, * * * is contagious, and a single diseased tree will, in a few years, destroy an orchard. Every one that looks sickly, and especially one that ripens any of its fruit prematurely, should immediately be dug up.²

Dr. W. S. Maxwell, who visited Harford County in the fall of 1887, and again in July, 1888, saw yellows in several small orchards between Aberdeen and Churchville. Along Deer Creek peaches grew well twenty years ago, according to Dr. James McGraw, but now the yellows destroys them before they reach bearing age. According to statements made by others, peach orchards were formerly plentiful in Harford, along the Bay Shore, from Spesutie Narrows down to a point opposite Poole's Island. Yellows destroyed these orchards. The disease now attacks young orchards when they first come into bearing, and soon destroys them.

Peaches are now grown in Harford County only to a limited extent.³

¹*The Country Gentleman*, 1862, p. 270.

²*Ibid.*, September, 1863, p. 209.

³James S. Harris, letter of January 31, 1888; W. S. Maxwell, M. D., letter of February 12, 1888. See, also, Map VIII.

In Baltimore County, which joins Harford on the west, peaches have been grown for market many years. As long ago as 1834, near Baltimore, Richard Cromwell grew peaches to such an extent that he was commonly called "the peach king."¹ His first orchard must have been set as early as 1810; and for several decades he supplied the city of Baltimore "with peaches of the best quality and on a large scale." According to Robert Sinclair, yellows was present in Mr. Cromwell's orchards prior to 1840, and it was his custom to dig out such trees with a view to preventing the spread of what he believed to be a communicable disease.²

Concerning the appearance and nature of yellows, Mr. Sinclair says:

I am fully satisfied that the complaint exists. Some persons say that the worm at the root is the cause of the yellows. I acknowledge that any disorder that destroys the trees will cause the leaves to turn yellow; but the complaint I call yellows will kill a whole orchard, without any visible wounds, on or before the third or fourth full crop. I think where any neighborhood abounds with peach orchards it will be nearly impossible to keep clear of the disease. * * * I think I have seen evidences of its being in some degree contagious.

His attention had been called to this disease occasionally "for about thirty years"—*i. e.*, since about 1810.

In 1887 S. H. Wilson, of Baltimore County, writing on "Peach Yellows in Maryland,"³ says that forty years ago trees "rarely, if ever, failed to grow and produce large crops for years," even when neglected.

Some years before the civil war his neighbor set out 10 or 12 acres of peach trees, which did well. Seven or eight years later this man set out two additional orchards of about the same size. "Before they came into bearing, the yellows, a thing heretofore unknown, attacked the old orchard and spread to the two young plantations; and I do not think his last two plantations produced a peck of fruit."

When he came upon his own place, seventeen years ago (1870), "it was nearly all planted with peach trees just coming into full bearing." Yellows was then present, and it gradually spread until now but one tree is left, although he has dug out, cultivated, and boned heavily. Of four trees set in 1870, one contracted the disease the third year; the rest after two crops. In 1882 he set twenty-seven first-class trees and kept the ground cultivated. "I have applied yearly kainit, high-grade muriate of potash, bone, and wood ashes; look for worms a dozen times a year; head back one-half of every branch, and now a good share of these trees have the yellows. My soil is a heavy loam; subsoil, yellow clay."

In 1887 I saw the disease in the following places on the "west shore:" In Harford County, at Havre de Grace and Edgewood; in Baltimore

¹ *Transactions of the American Institute*, 1849, Albany, N. Y., 1-50, p. 292.

² Robert Sinclair, Clairmont Nursery, near Baltimore, March 1st, 1841. *Magazine of Horticulture*, VII, p. 210. Quoted in *Farmer's Register*, Pittsburgh, Va., 1841, pp. 357, 358.

³ *The American Garden*, New York, 1887, p. 72.

County, in the twelfth district; in Anne Arundel County, at Odenton. I have also been informed that the disease occurs in Prince George County, and believe this statement to be correct. The disease also occurs in the mountains of Washington County and in other parts of west Maryland.

The yellows also occurs in the District of Columbia. In 1886 I saw several trees evidently diseased by it for a number of years, and then in a dying condition. In 1887, in yards and gardens in various parts of the city of Washington, I found no less than twenty trees showing unmistakable signs of yellows, *i. e.*, bearing the pale, puny, much-branched summer shoots. In all but one or two of these trees the disease had evidently developed that year or the preceding.

Virginia.—The disease occurs to some extent on the west bank of the Potomac, in the vicinity of Washington, where I saw it in 1886.

It has also been reported from other parts of the State,¹ and was present as long ago as 1849, if we may credit the following statement made by Yardley Taylor, of Loudon County, in his report to the second congress of fruit growers convened in New York City:

Peaches succeed well here. It is no uncommon thing to see trees thirty or forty years old. The yellows occasionally are seen, and where no efforts are made to extirpate those that are affected, the disease has in some places destroyed many trees.²

Similar statements were made in 1852 by a committee of the American Pomological Society at the Philadelphia meeting of that year.³

South Carolina.—In 1877, The Southern Cultivator published some curious statements as to the wide variation in time of ripening of peaches in South Carolina. This variation was attributed to locality and external influences,⁴ but is a suspicious indication. It would not, therefore, be surprising if yellows were found to exist in that State.⁵

Georgia.—The first orchards, as we have already seen, were set as early as 1730, perhaps earlier, soil and climate both appearing to be congenial. Budded peaches were not, however, planted very extensively until after the civil war. This State now grows peaches for commercial purposes, and there are some very large orchards in the middle west part.

That yellows exists anywhere in Georgia has never been clearly established. Repeated inquiries during the last thirty years of prominent peach-growers living in this State have always elicited such responses as the following: "Yellows does not exist in Georgia." "It has never appeared here." "It is a disease of northern climates."

The published evidence in favor of its occurrence in Georgia is very meager.

¹ *Report on Condition of Growing Crops, August, 1887*, Washington, D. C.

² *Trans. of the Am. Inst.*, 1849, pp. 294, 295.

³ *The Plough, Loom, and Anvil*, Vol. V, part II, p. 38.

⁴ *The Cultivator and Country Gentleman*, Albany, N. Y., 1877, p. 413.

⁵ See *Condition of Growing Crops, August, 1887*, United States Department of Agriculture, p. 375.

In 1877, T. T. Lyon, of South Haven, Mich., received a number of young trees from P. J. Berckmans, of Augusta, Ga. One of these trees developed that season, on Mr. Lyon's grounds, a very characteristic wiry growth on the stock below the graft, and the next season the top of this tree also became diseased with what he considered to be unmistakable yellows.¹ Mr. Lyon believes the disease was dormant in the tree when it was removed from the Georgia nursery, but as peach yellows existed in other orchards at South Haven at that time, the evidence that this tree became diseased in Georgia is not entirely conclusive.

I know of one other reason only for suspicion. There is a disease of peach trees in middle Georgia, in and near Griffin, which is entirely distinct from the effects of borers or of starvation, and is said to kill the trees in two or three years. I have not visited that locality, but have received numerous specimens gathered at different times of the year, and judging from these and from accounts of the disease furnished by J. D. Husted, of Vineyard, Ga., and by James N. Harris, of Griffin, I am inclined to think it is yellows. Mr. Husted's description is as follows:²

The whole tree usually assumes a sickly appearance; the leaves are very small and slender, with a yellow death-like look. Late in the season or second season of the attack the tree ceases to make terminal growth, and a bunch or rosette of leaves forms at the tips of limbs, making the tree conspicuous at a distance.³ Trees thus attacked are sure to die the second or third year. The symptoms differ from the yellows as known in Michigan. So far as I can learn, it is not infectious, as single trees are often allowed to stand in the orchard until they die (which they are certain to do), and the nearest trees remain healthy. The small wiry shoots do not appear on the main branches, as they do in the North, and I believe (though not quite sure) the diseased trees are barren of fruit from their first attack.

In 1888, Mr. Husted wrote again as follows:⁴

The lot in top of box * * * is from a small tree just attacked this summer, and is the only case I have found where the whole tree was not attacked at once with the disease. You will notice that some of the branches are apparently healthy although the whole of the base of the tree appears affected.

The second and last specimens * * * are from a strong tree, six years old, and every part is diseased like the specimens I send you [same as Photo. XVI]. This last tree, as well as the first, showed no symptoms of disease last summer that I noticed, but from the fact that it shows so complete development of the disease now, it is quite probable that it escaped my notice last season. I am of the opinion the first symptoms of disease, in this locality at least, are not so manifest as in the North. I have found no person yet who has ever seen a tree with the disease in bearing, and although several trees have fruited prematurely this season with fruit of large size, yet the flavor was good—a little more astringent than usual; the surface was not high colored, and the flesh of the fruit was of the usual color in sound fruit. * * *

In my orchard of 6,000 trees, from three to six years old, I dug up last season three [such] trees, and this season have taken out two, and have two more to dig out.

¹ Conversation of May 1, 1888; see, also, *Ann. Rept. of the Sec'y of the Mich. State Pom. Soc.*, 1878, p. 258; 1880, p. 273, and 1884, p. 177.

² Letter of September 20, 1887.

³ See Plate No. V of Washington tree, and Plates Nos. XVI, XVII, XVIII, photographed from Georgia specimens.

⁴ Letter of June 18, 1888.

Some old and neglected orchards are diseased still more. It is the opinion of several of the fruit-growers that the disease is on the increase.

Peach trees here grow along the hedge-rows and streams and the woodlands, and trees [thus] diseased are occasionally found in these places.

June 6, 1888, I received specimens from J. N. Harris, of Griffin, Ga., which proved identical with those sent in May and June by Mr. Husted, of Vineyard. The letter accompanying these says:

There are a good many trees in this section now in this condition. They grow one year this way and the next they die. I don't know one that has ever recovered.

In answer to my inquiries Mr. Harris sent an abundance of specimens (see Photos. XVII and XVIII), and, speaking for the Middle Georgia Horticultural Society, of which both he and Mr. Husted are active members, made a number of important statements,¹ which I summarize as follows:

Peaches have been grown in the vicinity of Griffin seventy-five to one hundred years, and within a radius of 7 or 8 miles there are now several thousand acres, with probably 150,000 trees. The soil is rolling, being mostly dry hill-sides with flats between them. The lands are usually rather thin and sandy or gravelly, with a clay subsoil. In some places they are more fertile. As a rule peach trees do best on the "good medium lands;" in rich bottoms they do not flourish. This disease first appeared in the vicinity from six to ten years ago. It is now in all the orchards. Usually about 1 per cent. of the trees are affected, but in a few orchards as many as 10 per cent. It appears to be on the increase, and is beginning to look serious. The trees never bear any fruit the year the disease is on, and are sure to die the next year. He also thinks they seldom bear any fruit the previous year, but does not wish to speak positively on this point until he has made further observations.

The Georgia specimens which I have examined differ from the yellows of Michigan and Delaware only in the following particulars:

(1) In the development of the diseased shoots in early spring from the ordinary winter buds, instead of later in the season from obscure or adventitious buds on the trunk and branches.

(2) In the excessive shortening of the shoot-axes whereby the branches and leaves of each shoot assume the form of a compact tuft or rosette.

However, in Maryland and Delaware diseased shoots are not strictly confined to obscure buds, as we shall see; and undoubtedly symptom No. 1 will not be found constant in Georgia. I should certainly expect to find some of the trees also putting out feeble shoots on trunk and larger limbs. Symptom No. 2 evidently results from the fact that *all* the living buds push in this manner, and the tree has not vitality enough to produce a normal shoot-axis from any one. By carefully removing the foliage, as in Photo. XVIII, the characteristic secondary and tertiary branches can be readily observed. Later in the season, I have no doubt, quartan and quintan branches could be found on some of these

¹ Letter of June 13, 1888.

shoots. Although in the photographs the tufts somewhat resemble leafy galls there is no reason to think that gall-flies or other leaf-infesting insects have anything whatever to do with their production. If the shoot-axes and their branches were elongated we should have growths identical with those shown in Photos. I, II, and III.

I have no doubt that further inquiries will show that this stage of the disease is preceded by the appearance of prematurely ripened fruit.¹

Kentucky.—The disease undoubtedly occurs in this State, but appears to be rare.²

Illinois.—The disease is said to exist in two places in southern Illinois—"near Duquoin, Perry County, and in the neighborhood of Villa Ridge, Pulaski County."³ Quite a good many peaches are grown in this part of Illinois.

Tennessee.—P. M. Augur, State pomologist of Connecticut, thinks he has seen the genuine peach yellows in this State.⁴

Mississippi.—Thomas Meehan also thinks he saw it in Mississippi, along the Jackson route,⁵ but this was denied by people in that region.

Louisiana.—In the proceedings of the American Pomological Society for 1875, p. 152, Dr. R. H. Day, of Baton Rouge Parish, gives an account of the loss of a peach orchard of 160 acres, about 1850-'53, and of two others about 1871-'73, by a disease very suggestive of yellows. The trees are said to have looked well and grown finely "till about their third or fourth year," when they sickened and died. No symptoms are given.

Texas.—Yellows has also been reported to me from the orchards on the south bank of Red River, but I have not seen specimens. It is said to exist only to a slight extent.

Summary.—All facts that I could discover by personal examination or gather by reading, conversation, or correspondence relative to the occurrence of yellows south of New Jersey and Pennsylvania have been presented in the preceding pages. They may be summarized as follows: (1) Peach yellows prevails extensively and disastrously in upper and middle Delaware and in upper Maryland. (2) It is absent or rare in southern Delaware, in southern Maryland, and in Virginia. (3) Evidence of its occurrence in the more southern States is very meager, and for the

¹ In November, 1888, I received additional specimens from Mr. Husted (see Photos XIX-XXI). In XX and XXI all the winter buds pushed in October, the same as in many Delaware and Maryland trees (see Photos I and XXVIII-XXXI.) These shoots come from two young trees which were procured in New Jersey and set in Georgia two years ago. About 30 out of 600 showed yellows in 1888. Photo XIX is from a tree grown and budded in Georgia, so also are Photos XVI and XVII. There need be no further doubt, I think, as to the nature of the disease, although I have not been able to visit Georgia or to get any further light on the question of the occurrence of premature fruit.

² *Condition of Growing Crops, August, 1887.* U. S. Dept. of Agri., pp. 375, 376.

³ *Ibid.*, p. 376.

⁴ *Annual Report of the Conn. Board of Agri.*, 1886, p. 345.

⁵ *The Gardeners' Monthly*, Phila., 1881, p. 83.

most part unsatisfactory, middle Georgia being the only place where I have established its presence with any degree of certainty.

CONCLUSIONS.

The literature of peach yellows is a medley of contradictions. All sorts of views have been promulgated, with greater or less show of wisdom, and many theories have been built on a very slender basis. It would seem that at least a personal acquaintance with the disease ought to be requisite to writing on such a perplexing subject, yet even this does not appear to have been thought necessary in all cases, those who knew the least having often expressed their opinions with the most confidence. In connection with my field studies, I have endeavored to find, read, and sift the whole of this voluminous and incongruous mass of writing, and in the preceding pages I have presented all that seems pertinent to the question of history and distribution. Wherever possible, the writers have been allowed to tell their story in their own way, only such portions being suppressed as seemed foolish, irrelevant, contradictory, or untrustworthy. Two reasons led me to quote rather than summarize and speak *ex cathedra*: (1) The inaccessibility of a very considerable portion of the early literature, some of which has been misquoted frequently. (2) A feeling, shared in common, I doubt not, with many others, that statements are more certainly to be depended upon when safely inclosed between quotation marks than when condensed or paraphrased.

Among the facts which I believe to be well established by this inquiry are:

(1) That yellows has frequently been confounded with other diseases of the peach, especially in New Jersey, where the borer and the root aphis are very prevalent.

(2) That genuine peach yellows appeared in the vicinity of Philadelphia prior to 1791.

(3) That since 1791 the country has never been entirely free from this disease.

(4) That it was prevalent on the Atlantic coast long before it appeared in the West.

(5) That the area of its action has extended northeast, north, and northwest much more rapidly than south.

(6) That it is now more or less prevalent from Massachusetts to Georgia and westward to Lake Michigan and the Mississippi.

(7) That the disease spreads from centers, usually appearing first in localities thickly set with orchards.

(8) That the first cases of yellows in any district are usually, if not always, in young trees imported from infected localities.

(9) That everywhere it is the same destructive malady.

Some deductions which may be accepted provisionally and with more or less caution are:

(1) The disease is confined to the United States.

(2) It is absent from the Gulf States and from those west of the Mississippi.

(3) There have been great outbreaks of the disease, *e. g.*, 1791, 1806-'07, 1817-'21, 1845-'58, 1874-'78, 1886-'87-'88, followed, apparently, by periods of comparative immunity.

II.—CHARACTERISTICS OF PEACH YELLOWS.

In the preceding pages, while dealing with the history and distribution of peach yellows, I have assumed it to be a specific disease. Is it really so, or is it only a sort of marasmus, due to various causes and itself as variable as the conditions which produce it? In other words, is the name yellows a misnomer and the disease a nonentity, as some would have us believe, or is there a well-defined set of symptoms to which this term may properly apply?

By the term specific we mean ordinarily a disease which runs a definite course and is characterized by a more or less peculiar set of symptoms, clearly distinguishing it from other maladies. Whether we know much, little, or nothing of the cause of a specific disease, of one thing we are never in doubt: it begins, progresses, and ends in a definite way; it can be defined; it is a genuine disease. Although in different individuals there may be peculiarities due to idiosyncrasy or to unknown causes, yet in its broad, essential features the disease is the same in all individuals, so that from the careful study of a few typical cases we can readily predict what will be the general course of the disease in any number of other cases. Instances of such diseases readily occur to all, *e. g.*, in man, consumption, small pox, diphtheria; in the lower animals, anthrax, glanders, swine plague; in plants, smuts, rusts, mildews. Each of these diseases is characterized by a very definite set of symptoms, so that we are in no great danger of mistaking one for another.

Unquestionably by the term yellows much confusion has arisen, different persons having used it to convey different ideas. By this expression some have meant simply the results of starvation, or the effect of very wet subsoils; others, no doubt, have had in mind that stunting peculiar to trees infested by root-aphides; others again, the effects of the peach-tree borer. By the term yellows I mean none of these things, though any one of them may cause the foliage to become yellow, and though any or all of them may be found in the tree along with genuine yellows, just as a person may at the same time have measles and whooping-cough, scarlet fever and diphtheria, or consumption and ague.

Peach yellows as it occurs in Michigan, and as I saw it in hundreds of trees in many orchards in Maryland and Delaware in 1887 and 1888, is a disease of haste and waste; the fruit ripens too soon; the buds push too soon; assimilation is disturbed; the stored starch and other food materials are wasted by excessive and unnatural growth; and the entire vitality of the tree is exhausted in the course of two or three seasons.

Healthy peaches grow somewhat slowly until a few days before the time of their maturity; then they increase in size rapidly, and all ripen at about the same time, this time varying with the latitude, but being quite constant for the same variety in any given locality. Upon the variability of different varieties, as to time of ripening and the constancy of the same variety, depends the peach season and the whole peach industry. For example, in middle latitudes of the eastern United States the peach grower knows to a certainty that he may expect the Early Louise or Early Rivers to be ripe at a given date in July; the Mountain Rose and Crawford's Early at two given dates in August; the Old Mixon, Stump, Crawford's Late, Smock, Bilyeu's, etc., at successively later dates. Consequently, in planting his orchards he takes great pains to select these varieties or others which mature in the same way one after another. To such an extent is this now carried that in the more favored localities, such as Maryland and Delaware, the "peach season" begins early in July and lasts until mid-October, there being between these dates a nearly unbroken succession of varieties. In a given latitude each one of these many varieties ripens, year after year, so nearly at a given date that months in advance the grower can tell to within a very few days at what time it will be necessary to pick and market any variety, and can arrange all his work accordingly. Soil, situation, and weather exert some influence, *e. g.*, peaches on light, warm soil usually ripen a few days in advance of those on clay.

Manifestly, if these varieties should ripen out of season or at nearly the same time, either the markets would be glutted and the price of peaches would fall below the cost of production, or else the fruit, unexpectedly ripe, would rot upon the trees for lack of sufficient help to pick it. In either event great losses would result.

This is very nearly what happens when an orchard is attacked by yellows. The disease is characterized by the following symptoms:

FIRST YEAR OF ATTACK.

The diseased fruit ripens prematurely, and frequently in such a way that varieties, ordinarily maturing several weeks apart, are ripe all at once, often quite unexpectedly. There is no time to gather this fruit, even if it were perfect, and much of it decays on the trees. It is also rejected by drying and canning establishments and by commission merchants, except in years of scarcity.

Diseased trees exhibit great variability as to time of ripening their fruit. Sometimes this period precedes the normal time of ripening by only two or three days; sometimes it precedes it by as long a period as six weeks or even two months, in which case healthy peaches on the same tree or on adjacent ones are not half grown. As a rule it may be said that such peaches ripen at least two or three weeks in advance of the proper time.

These prematurely ripened peaches differ from healthy ones very

materially in color. Once seen they can never be mistaken. Generally they have more color than healthy peaches, but the essential difference lies less in the amount of color than in the peculiarity of its distribution. Instead of being delicately punctate with minute crimson dots or imbued with uniform masses of color, like the ruddy cheek of a healthy peach, the surface is coarsely blotched with red and purple spots, of variable diameter but usually not less than one-sixteenth of an inch across. These give to the peach a mottled or speckled appearance unlike that produced by any other disease, and so entirely different from the healthy appearance, that the yellows might in many cases be diagnosed from a very small fragment of the skin of a single peach (see Photograph XIII and colored plates XXXIV and XXXV). Sometimes these spots are infrequent; sometimes they are very numerous. Usually they are somewhat sharply defined on a much lighter background, but sometimes they coalesce, giving to the whole peach a dark crimson or purple color, or, more rarely, a brown purple or dull red.

These red or purple discolorations are not confined to the skin of the peach, but extend into its flesh, appearing on tangential section as roundish crimson spots, and on radial section as more or less irregular dots, streaks, splashes, or veins of color. These streaks extend entirely through the flesh from pit to skin, or only part way in or out (see sections in colored plates). Always there is more than the usual amount of crimson color about the pit. Sometimes, especially in white-fleshed peaches like Troth's Early, Mountain Rose, and Old Mixon, the whole interior is mottled with the brightest crimson, or becomes a nearly uniform mass of this deep color.

In some instances, in yellow varieties, particularly in Maryland, the flesh of the prematures was not very high colored; and in two or three cases I found scarcely a trace of crimson-spotted flesh. Noyes Darling also mentions one instance in which the usual high color was wanting, the only exception he ever found.

The taste of peaches ripened prematurely by this disease varies considerably. Usually they are insipid and worthless for eating; occasionally they retain a nearly normal flavor, and not rarely they are slightly bitter or mawkish.

Such peaches seem to decay more quickly than healthy ones. Judging from my own experience, the palatable ones are not injurious even when eaten in large quantities. Most prematures, however, are unfit to eat.

If the tree is in bearing, this prematurely ripe, red-spotted fruit is the first symptom of the disease, at least the first unmistakable symptom. Not infrequently out of several hundred peaches upon a tree I saw the disease in one or two only, and very often it was manifest only in the peaches on one or two small limbs; sometimes, however, the disease showed itself simultaneously in peaches on all parts of the tree,

affecting nearly or quite all of them, the disease appearing to have attacked all parts of the tree at once. Occasionally I saw trees loaded almost to breaking with such peaches and they were as large as those on healthy trees.

When the tree had been healthy the previous season, and especially when the diseased peaches were confined to one limb or to a few limbs, I found the branches and foliage perfectly normal in appearance. Indeed, judged solely by their foliage and young wood, many of the diseased trees which I examined in Maryland and Delaware in July and August, 1887, would have been pronounced very healthy, the only symptoms I could find being the prematurely ripened, red-spotted fruit (see colored plate XXXIV).

Upon some of these trees at this time, and later in the season upon many others, I found young shoots developing into a most strange and unnatural growth. On many trees this was very striking, filling the whole interior of the tree-top. To it the expression "fungus growth" is often applied by peach-growers, although it is a part of the tree itself and no fungus. This abnormal growth is so peculiar and so characteristic of yellows that it deserves to be considered at some length as the next morbid manifestation. This growth appears to be a secondary symptom, although upon barren trees it may be the first to appear, as it is often the first to attract attention. My reason for thinking it is a secondary symptom is that while limbs often bear premature peaches for one season without showing this diseased growth, they never in any instance send forth this growth and at the same time or afterward produce healthy peaches. Having once borne these starved shoots they always thereafter bear diseased peaches, if they bear any. This growth consists of more or less depauperate shoots which are often much branched, so as to be suggestive of what the Germans call "Hexenbesen" or witch brooms, some of which are known to be caused by fungus attacks. There is not only a polycladia, but there is a marked prolepsis. These shoots may appear upon any part of the tree, and often are developed numerously upon the trunk and main limbs, from obscure or adventitious buds. Most commonly I found them growing out close together upon the upper side along the entire length of a main limb, or of several such limbs, giving the interior of the tree-top a very peculiar appearance, entirely unlike that caused by any other disease (see Photo. VIII). Where these shoots appeared numerously upon a limb they were frequently unbranched and only a few inches in length, at least in July and August. More often, especially late in the season, I found them branched (see Photos. I and III). In some instances these diseased shoots and their branches were very long and willowy. Often the leaves also suggested the willow.

The manner of this branching was to me a striking peculiarity, and one which I had never seen mentioned in connection with the disease. There is, as we have seen, an excessive duplication of shoots. Shoots,

it is true, are likely to occur to some extent upon the trunk and main limbs of all robust trees, but never in such numbers, nor branched in the manner to be described, nor with such a starved appearance. Not only are the shoots dwarfed and sickly but their growth is extremely hurried, *i. e.*, in their leaf axils they develop buds which the same season give rise to diminutive branches, and in turn these branches in the same way give rise to others. Very often I found that three sets of branches, and in some instances four or even five, had developed on these shoots as the result of a few months' growth. These branches are very clearly shown in some of the photographs accompanying this report, as may be seen by comparing them with contemporary healthy growths. For instance, Photograph XIV, from a healthy tree, shows two unbranched shoot axes which are strictly comparable with the much-branched diseased growth of No. II. The tissues of these branches are very poorly developed and their buds are diminutive and very often dead before they enter the winter, differing in these respects from the few witch brooms I have had opportunity to examine. Moreover, there is never any hypertrophy of the branches which bear them. The foliage of such shoots is often blanched or pale yellowish green, and never of a vigorous green. It is abundant but very much dwarfed, the best developed leaves being frequently less than 3 inches long and proportionately narrow, and many of the smaller ones being less than an inch in length, while full-grown, healthy leaves are from 6 to 9 inches in length by $1\frac{1}{4}$ to 2 inches in breadth. Frequently by failure of the internodes to properly lengthen and by the excessive production of branches the growth becomes considerably tufted, much more so than is shown in any of the accompanying photographs, except those of the Georgia specimens, Nos. XVI and XVII.

As autumn passes away these diseased shoots manifest no signs of preparation for winter (see Photo. V). There appears to be something analogous to what in animals would be called a lack of innervation. The ordinary functions of the plant are disturbed or set aside altogether. Growth goes on without much reference to the needs of the plant or the time of the year, and is at the same time excessive and imperfect. In late October and in November, when healthy trees had dropped their leaves and were ready for winter weather, such shoots were still growing.

Although these diseased shoots appear to be a secondary symptom, yet they may follow the diseased fruit speedily. In autumn I saw them on many trees which were not diseased the previous year, or at least showed no external manifestation of disease; and in nearly all such cases they were *secondary* growths from obscure buds, first appearing in June or July or later in the year, the *primary*, terminal, or spring growth being usually the picture of health, as regards both branches and foliage. However, this was not *uniformly* the case, for occasionally in August I found terminal shoots which had become much branched

and were otherwise diseased exactly like those shoots which grew from obscure buds on the branches or trunk (compare Photo. II with I, III, or IV). This manifestation of the disease upon terminal shoots appears not to have been observed very generally. A. J. Downing says it never occurs;¹ A. G. Gally never saw it.² Possibly, it is more prevalent in the South. In Georgia it occurs early in the season and appears to be the common form of the malady, whole trees of robust growth being diseased nearly or quite throughout, as shown in Photos. XVI and XVII.

In September and October I also saw not a few yellows-infected trees, on which all the buds of certain terminal shoots had just begun to develop into branches, although these shoot axes had previously appeared healthy throughout. Often, much earlier in the season, I saw robust shoots from the trunk and main limbs, the lower parts of which showed every indication of health, the leaves being large and dark green and the wood and bark all that could be desired; yet, as growth progressed, these lusty shoots, some of them 4 or 5 feet long, developed at the apex into a complex of repeatedly ramified, feeble branches covered with innumerable diminutive, pale-green, willowy leaves. Sometimes from a healthy-looking main limb grew out two yearling shoots within an inch of each other, one of them being diseased in the manner described and the other being unbranched and perfectly healthy, with vigorous dark-green foliage. Such shoots were upon trees but recently attacked.

The relation of the diseased to the healthy portions of the tree were in some instances quite peculiar. The following are some of the more interesting cases, observed in August and September, 1887:

Occasionally the diseased shoots grew out of the trunk or from the main limbs, while nowhere else were there any indications of disease, such trees being barren.

Sometimes the diseased shoots grew out immediately above or immediately below a healthy branch.

Midway of its length a diseased branch sent out well-developed shoots, then two years old, which bore healthy leaves of normal size. This branch may have become diseased the previous year.

Midway of a healthy branch grew out a very characteristic yellows tuft. Lower down grew out several branches, large and small, bearing full grown, dark-green leaves, while above the sickly tuft the branch divided four times and the sub-branches ramified considerably, all the parts bearing healthy leaves.

On one part of a tree the limbs bore very healthy foliage and sent out from their base exceedingly stocky yearling shoots, which were 4 to 5 feet long and bore large, healthy, dark-green leaves. One limb, however, of this tree, also bearing healthy spring foliage, sent out along

¹ *Fruits and Fruit Trees of America.* N. Y., John Wiley & Son, 1865, p. 595.

² *Annual Report of the Sec'y of the Mich. State Pom. Soc.*, 1878, p. 258.

its branches, from obscure buds, many of the characteristic, secondary, small, starved, light-green twigs.

Prematurely ripe peaches were sometimes found upon every main limb mingled with healthy green ones.

A tree bore premature peaches on every main limb and put forth a hundred or more of the starved, secondary shoots from obscure buds on the body and limbs, and yet showed no sign whatever of disease in the spring foliage or in the growth of any of the terminal shoots, every one of these being well developed and provided with full grown, fine looking leaves.

In another instance these pale, sickly shoots came out unbranched (August) singly all over the tree, except on the trunk, the extreme base of the main limbs, and the shoot-axes of the season. This tree was six years old and well developed. If it hung full of healthy peaches the previous year, as I have reason to believe from the assurances of the owner and his tenant, then it must have become diseased some time between September, 1886, and June or July, 1887, unless we assume that the tree may be diseased for some time without external manifestation.

As already noted, premature peaches were frequently observed upon branches apparently sound.¹

In one instance numerous secondary shoots grew out erect, along the whole length of the branches much as if the tree had been defoliated and were making a desperate effort to get new leaves; yet the terminal shoot-axes of this tree (the spring shoots) had in every instance made a good growth of 1 to 2 feet, and bore full-grown, dark-green leaves, except on some small branches in the center of the tree where they were beginning to look yellowish-green and unhealthy. In this tree even the terminal shoots were beginning (August 16) to put out miserable, starved branches, 1 to 2 inches long, from the axils of their lower leaves; and I am inclined to think it may have been affected in some part the previous season.

These two symptoms—prematurely ripe, red-spotted peaches; and pale, diseased, dwarfed shoots, strongly inclined to prolepsis and polycladia—are the only ones I could find in trees that were healthy the year before. Most frequently both symptoms were present. In some parts of the country, however, the diseased shoots do not appear so abundantly, and sometimes not at all until the second year. Perhaps seasonal or climatic peculiarities may control this. They are certainly more numerous in rainy than in dry seasons.

SECOND YEAR OF ATTACK.

The symptoms of the second year include those of the first, and there are several additional ones.

The fruit is usually smaller and less abundant, and the kernel is often abortive. The flavor of the fruit is also very inferior. It prematures

¹ The foliage of many such branches was observed to be yellow and badly diseased in 1888, and generally the shoot-axes of that season were also much dwarfed.

with the same general appearance as the first season. Quite often the tree is barren, if diseased throughout. I have observed many such instances.

The diseased shoots continue to grow from the affected limbs, those of the previous year, if any grew, being for the most part dead (see Photos. VIII, IX, and X).

There is also a progressive development of the disease, more and more of the tree becoming involved. In other words, it appears first to be a local disease; then, later on, a general one. Quite often, the first season, only one limb or a few limbs are diseased (left side of Photo. VIII), but additional limbs are invariably affected the second year. I know of no exception to this. The first year of attack it is comparatively infrequent to find a tree diseased in all its parts; the second year it is somewhat rare to find many sound branches; often there are none (see Photos. VIII, IX, and X).

Another symptom, not very noticeable the first year, is the dwarfed, yellowish or reddish-brown, and more or less curled and inrolled appearance of the entire foliage of the tree, or at least of all that on limbs diseased the previous year. This appearance renders diseased orchards plainly distinguishable at some distance, and no doubt gave rise to the name yellows, as applied to this disease. At this stage the most careless observer is aware that something is wrong with the orchard. The trees have a most miserable, sickly, languishing appearance. Some curling and inrolling of the leaves is undoubtedly due to mites or other leaf insects, but I could not satisfy myself that all of it was so caused. It should also be stated that the leaves on the diseased, secondary or summer shoots do not ordinarily show this rolling and curling. Frequently there are brown or red spots upon the foliage, but this is not a constant symptom and appears to be due to a leaf fungus (*Cercospora*), which finds in the diseased leaves its most favorable condition for growth.

THIRD AND LATER YEARS.

The diseased tree rarely dies the second year of attack and rarely lives beyond the fourth or fifth year. It is generally worthless after the second year, *i. e.*, after all the branches have once borne the premature peaches; sometimes it becomes entirely diseased and worthless the first year of attack. Whatever may be thought of remedies, it is certain that left to itself the diseased tree invariably dies. It is not more likely to recover than is a consumptive animal. I have heard it said that such trees sometimes recover, but none under my own observation have done so, nor can I find satisfactory evidence of any such recovery.

The symptoms of these later years are those previously mentioned, to which may be added some additional ones due apparently to an increasing lack of vitality. One of these is the death of large limbs and, finally, of the entire tree (see Photo. XI). Sometimes as early as the second year, and quite often the third or fourth year, the only symptoms of

life exhibited by the tree are a few very feeble, dwarfish, broom-like tufts of branches, developed from obscure buds, here and there upon the otherwise naked limbs (see also Photo. III, which may be compared with XIV and XV, from healthy growths 1887 and of 1888). These branches are clothed with very depauperate leaves of a greenish-yellow or reddish-brown.

Some additional minor symptoms attracted my attention, but not being certain that they are constant I present them here as suggestions rather than final conclusions.

The diseased shoots appear very brittle. I first noticed this in trying to make some withes, and afterwards found it nearly or quite constant. This recalls a statement made by Noyes Darling that diseased branches lose their elasticity and sway in the wind with "a stiff, jerking motion."¹ I did not meet this statement until my field work for 1887 was completed, but, in connection with the brittleness, I am inclined to give some weight to it, particularly as Noyes Darling seems to me to have been the most acute observer and the most logical thinker who has ever written upon peach yellows.

In diseased limbs I also found that the cambium-cylinder was active very late in the fall, as might be expected from the prolonged growth of leaves and shoots already mentioned. This activity of the cambium continued long after it had ceased upon the neighboring healthy trees. This was indicated by the ease with which the bark could be peeled. In Kent County, Del., in all cases, the bark of healthy trees stuck tightly and could not be peeled at all after the last of August. From diseased branches in the same orchards long strips of bark could readily be separated as late as September 20, leaving exposed the smooth, moist surface of the wood.

I should expect to find these symptoms correlated with peculiarities of microscopic structure, some of which might perhaps prove of diagnostic value, but up to this time I have not been able to make the necessary number of careful observations. What induces this prolonged activity of the cambium remains to be determined. It is apparently something in the nature of an irritant.

Other abnormal appearances, *e. g.*, the black heart-wood, mentioned as symptomatic by various observers, and the cracked and discolored bark found by Professor Penhallow, were objects of diligent search and were observed occasionally. However, not having found these two symptoms constant in yellows-infected trees, and having found the same in many trees not diseased by yellows, and even in localities where yellows has never appeared, I am constrained to rule them out as not peculiar to this disease. I think peach stems are apt to become black-hearted by severe freezing or from very slight injuries, if at all exposed to the weather. The appearance of the bark on trunks and main limbs was noted with great care in hundreds of trees, diseased and healthy. In the early stages of the disease in almost all the younger trees, *i. e.*,

¹ *The Cultivator*, Albany, N. Y., 1845, pp. 60-62.

those under six years of age, the outer bark was smooth and fair. In older trees the bark is naturally more or less rough and cracked. I could find nothing in color or cracking of the bark which appeared to me to be of diagnostic value, although in some cases, on shoots of but a few years' growth, the production of cork in irregular patches appeared to be excessive. Whether this is a peculiarity of any importance remains to be determined.

Since, in spite of all that has been said and written on the subject, there is still much confusion in the minds of peach-growers as to exactly what constitutes yellows, I have thrown my conception of it into the following propositions, the symptoms being noted in order of appearance :

DIGEST OF SYMPTOMS.

- (1) Prematurely ripe, red-spotted fruit.
- (2) Development upon the trunk and branches, which bear, or have borne, the diseased peaches of secondary or summer shoots, often in great numbers, and always dwarfed and feeble in appearance.
- (3) A very marked tendency of the buds on these secondary shoots to develop the same season, forming sometimes in this way within a few months secondary, tertiary, quartan, and quintan branches.
- (4) The appearance of the disease the next spring in the entire growth of the tree, or at least of the diseased parts—the shoot-axes being shortened and the foliage dwarfed and sickly, of a yellowish or reddish-brown color, and with a greater or less tendency to curl from end to end, and to roll sidewise, so that the lower surface becomes the convex outer surface. Sometimes, however, the disease affects the terminal shoots the same autumn causing the winter buds to develop either before or after the leaves have fallen.
- (5) A slow progress of the disease from limb to limb, so that in one or two years, or at most three years, the whole tree is involved.
- (6) Co-ordinate with the progress of the disease from part to part, a marked diminution of the vitality of the tree, ending in death.

These are symptoms characteristic of peach yellows, and they seem to me quite as definite as those of any specific disease. If peach yellows, as I have seen it and have defined it, is not a specific disease, due to some constant cause or causes, then neither is glanders or anthrax, or measles or small-pox.

DISEASES MISTAKEN FOR YELLOWS.

Having defined yellows, it will now be proper to state what it is not ; *i. e.*, to describe somewhat carefully those abnormal appearances for which it has been mistaken. This is the more necessary because many growers, and even some writers upon the subject, have never seen genuine yellows, and because some of these abnormal appearances are likely to be found in every peach orchard and to cause unnecessary apprehension.

(1) *The borer*.—The larva of *Egeria exitiosa*, Say, devours the inner cortex of the tree at the surface of the earth, or immediately above or below, often causing extensive destruction, and not infrequently girdling the trunk.

If these injuries are slight the tree is not harmed, but if they are extensive there is a marked yellowing of the entire foliage, the leaves being also more or less folded sidewise, upward, along the midrib, and curled downward end to end. The fruit in some cases also ripens prematurely (see Plate XXXVI). Thus injured, the tree presents a very sickly appearance, and generally dies in a year or two, the symptoms being not markedly different from those manifested by any tree when some portion of the trunk-cylinder is deprived of the whole or greater part of its bark.

This disease is easily distinguished from yellows. If the foliage is very yellow, an examination at the base of the trunk will show that a large part of the inner bark has been destroyed, and will often discover the larva still at work. If such trees are vigorously shaken in July or August the yellow leaves will fall in a shower; but no amount of shaking will dislodge the leaves of a tree infected by the yellows. So tightly did the latter stick to the branches that, even in September, when I undertook to remove them from some of the much-branched secondary shoots, considerable force was necessary. Indeed the process was likened not inaptly by one farmer to picking pin-feathers from a starved chicken.

The prematurely ripened fruit, so far as I have seen, is natural in color and resembles that produced by the gardener's device of "ringing" or girdling, being found only on nearly or completely girdled trees. It is never red spotted, never associated with dark-green foliage, and never connected with those hasty, much-branched and feeble summer growths which are always found on trees badly diseased by yellows. Usually also this fruit ripens only a week or two in advance of the normal time and retains its normal flavor. The only case in which the two diseases can be confounded is where they both exist in the same tree.

(2) *The root aphis*.—A very shining dark-brown or black aphis, which corresponds nearly to *Aphis chrysanthemi*, Koch, but which I have not been able to identify with certainty, infests the roots of the peach often in such vast numbers as to interfere seriously with its growth or to kill it outright. This insect is common to parts of New Jersey, Maryland, and Delaware, particularly on sandy land. It frequently so stunts trees that at three or four years of age they are but very little larger than when first set (compare Photos. XXVI and XXVII). The insect occasionally infests whole nurseries, and may be distributed in this way. Possibly this may be an explanation of the fact that peach trees are most likely to suffer from root aphides the first year or the second year after they are set. Such trees are said to be "Frenched."¹ The foliage

¹This curious expression is also applied to corn and tobacco which makes a diseased or spindling growth. Its use is apparently as old as the settlement of Maryland, the opprobrious epithet "Frenchmen" having been applied to spindling tobacco plants by the first English settlers. See Clayton's *Virginia*, London, 1688, Force, Vol. III.

partakes of the universal stunting and is usually somewhat yellowish. In districts where yellows has not appeared I found this disease called by that name, and have no doubt it has often been mistaken for it, particularly in New Jersey.¹

There is no question but that the root-aphis has killed thousands of trees, and been in some sections a very serious obstacle to successful peach culture, although it is not so much to be dreaded as the yellows. The marked feature throughout is the stunting, something which is not a precursor of yellows nor characteristic of the earlier stages of that disease. After a year or two of languishing such trees also not infrequently recover. Upon none of them have I seen premature, red-spotted peaches and the characteristic diseased shoots except when the tree was also suffering from yellows.

(3) *The peach nematode*.—A species of *Anguillula* infests the roots of peach trees in Florida and probably also in some other portions of the country, although I have never observed any on the Chesapeake and Delaware peninsula or in the peach districts of Michigan. This minute worm produces knobsy enlargements and excrescences on the smaller roots, in which usually the cysts of the parasite may be detected. In this way the roots are often badly injured, and the tops become yellow and die, but, so far as I can learn, with no symptoms peculiar to yellows. I have seen only the infected roots.

(4) *Decay of roots*.—Southwest, in Arkansas and Texas, the peach is reported to suffer considerably from root-rot. In what way this affects the parts above ground or whether its manifestations are likely to be mistaken for yellows I am unable to say.

(5) *Starvation*.—Trees set upon pure sand or upon peat make a very feeble growth, although usually managing to live for some time. This starved condition, which readily disappears when suitable fertilizers are applied, might, possibly, also be mistaken for yellows, although I do not think it very likely, as such soil is generally well known to be barren and will not grow any fruit trees satisfactorily. Certainly this trouble would never be confounded with yellows by any person familiar with that disease.

(6) *Wet subsoil*.—Sometimes, by inexperienced growers, peach trees are set upon cold, wet soils. If these trees do not die outright they grow very slowly and produce only dwarfed yellowish foliage. I have seen such cases in a number of orchards, and believe the sickly appearance was due entirely, or at least primarily, to the nature of the soil. Few persons would, I think, be likely to mistake this for yellows. The premature peaches and the diseased shoots are wanting, and the unfavorable situation is a sufficient explanation of the symptoms which do appear.

¹ *The American Farmer*, Baltimore, Md., 1875, pp. 100-102; *The Gardeners' Monthly*, Philadelphia, Pa., 1880, pp. 206-207, and 1884, p. 303.

III. LOSSES DUE TO YELLOWS.

DESTRUCTIVE NATURE OF THE MALADY.

This may be shown in various ways, but perhaps in no better way than by a detailed statement of the condition of some of the many orchards visited in 1887, representative ones being selected for that purpose. The force of the following statements will also be enhanced if it be remembered that with one exception these are all young orchards, and that, in this same region, peach orchards unmolested by yellows remain healthy and productive for periods ranging from fifteen to thirty years.

(1) *Orchard of Dr. W. S. Maxwell, Still Pond, Md.*—Examined at various dates in August, 1887. Re-examined August 7, 1888. This orchard is situated in Kent County, on a neck of land near the mouth of Sassafras River, in the heart of a very important peach district. It is known locally as the "Gunnery Point" orchard. The trees were set in the autumn of 1882, the field being specially selected for peaches on account of its situation and fertility. They were procured from a neighboring nursery, were carefully planted, and received each year thereafter clean culture and all necessary attention. The trees made a smooth, thrifty growth, and did not exhaust themselves by overbearing, the orchard having never produced a full crop.

Yellows first appeared in 1886, when a few of the trees bore premature peaches, but did not send out the diseased shoots. When I examined the orchard in August, 1887, it contained 518 trees, 219 of which were healthy, 279 diseased by yellows, and 20 doubtful (see Map I). Some of the 279 trees bore premature peaches, others were barren. Many of them bore great numbers of the diseased shoots, and presented a very yellow and languishing appearance. Some of them were nearly dead. Those that were healthy appeared to be as thrifty as any peach trees. See Table I for per cent. of loss and distribution by varieties.

TABLE I.—*Orchard of W. S. Maxwell, Still Pond, Md.*

Variety.	Number of trees planted.	Number diseased by yellows in 1886 and 1887.	Per cent. of diseased.
Christiana.....	106	136	69
Gary's Hold On.....	222	80	36
Reeves' Favorite	100	63	63
Total	518	279	54

In 1888, 176 of the remaining healthy trees became diseased, *i. e.*, 74 per cent. In autumn the whole orchard was removed and the field sowed to wheat.

(2) *Orchard of Charles H. Price, Still Pond, Md.*—Examined August 16, 1887. This orchard is about 1 mile west of No. 1, on higher, lighter ground. The farm lies in part on the Sassafras River, in part on Chesapeake Bay. The trees were set in the spring of 1881, and have received clean culture and careful attention, the orchard having been liberally fertilized and plowed and harrowed each year like a cornfield.

Yellows appeared in 1884, when some of the trees first bore premature fruit. The disease has increased in extent and severity until it is now in all parts of the orchard. Many trees have been removed, and many more are badly diseased and valuable only for fuel. Until it became diseased this orchard made a good growth. It has borne several crops. In August, 1887, its condition was as follows:

TABLE II.—*Orchard of Charles H. Price, Still Pond, Md.*

Variety.	Number of trees planted.	Number dug out on account of yellows prior to 1887.	Number diseased by yellows in 1887.	Total dead and diseased.	Per cent. of dead and diseased.
Mountain Rose	120	52	45	97	80
Crawford's Early	312	87	100	187	60
Reeves' Favorite	474	93	81	174	37
Old Mixon	269	47	14	61	23
Stump the World	542	103	33	136	25
Crawford's Late	568	79	53	132	23
Beers' Smock	680	99	67	106	25
Total	2,974	560	393	953	32

No account is here taken of 130 Beers' Smock planted in a low spot in the southwest corner of the orchard, all of which have been removed, and about 100 of which were taken out on account of yellows.

In 1888, 257 became diseased, *i. e.*, 13 per cent. of the remaining healthy trees. The per cent. of the previous year was 16.

(3) *Orchard of Charles H. Price, Still Pond, Md.*—This small orchard lies next to No. 2, on the north side. It was planted with Waterloo, Early Rivers, Troth's Early, etc., and has received as careful treatment as the other orchard. The trees were set in 1883, and have made a strong, vigorous growth. This orchard has never exhausted itself by bearing, and was entirely healthy until 1887. In August of that year 91 trees out of a total of 209, *i. e.*, 43 per cent., were badly diseased by yellows, and some of them were a sight to behold, the whole interior of the tree-top being filled with the pale, starved, secondary shoots.¹ In 1888, 90 of the remaining 118 trees became diseased, *i. e.*, 76 per cent.

¹ I observed many other cases of rapid spread of yellows. Two may be cited here:

(1) An orchard of 10 acres (1,000 trees) on the "Bloomfield" farm, now owned by F. H. Harper, and located on the south bank of Sassafras River, not far from Still Pond, is now entirely ruined by yellows. I examined it in 1888 and found only 77 healthy trees. A few trees may have been diseased in 1886, but the disease was not

(4) *Orchard of J. Frank Wilson, Still Pond, Md.*—Examined August 19, 1887. Re-examined August 10, 1888. This orchard is on only moderately fertile upland, near the village, some miles from the river. It was set in the spring of 1878, and each season, up to the last of June, has been cultivated as carefully as a cornfield. The trees commenced to bear at three years, and have yielded abundant crops of good fruit.

Yellows first appeared in this orchard in 1882, when it was four years old, in one tree only on the extreme north side, in Troth's Early. This tree bore premature fruit, but showed none of the diseased shoots. In 1883, two other trees near this first one contracted the disease, and that year all three bore the diseased shoots. The third year, 1884, about forty trees had the disease, and were dug out and drawn to the house for firewood. In the fall of 1885, and again in 1886, all trees that had shown any signs of the disease were cut down and dug out and were removed. Previous to 1887, in this way 87 trees had been removed, and 47 others were then diseased.

The following table shows the loss by varieties:

TABLE III.—*Orchard of J. Frank Wilson, Still Pond, Md.*

Variety.	Number of trees planted.	Number removed on account of yellows prior to 1887.	Number diseased by yellows in 1887.	Number diseased by yellows in 1888.	Total dead and diseased.	Per cent. of dead and diseased.
Early Louise	40	6	5	4	15	38
Troth's Early	100	39	19	15	73	73
Reeves' Favorite	75	8	15	6	29	39
Stump the World	75	6	2	0	8	11
Crawford's Late	100	9	3	0	12	12
Beers' Smock	100	16	7	1	24	24
Bilyeu's October	25	2	0	0	2	8
Shipley's Late Red	125	0	0	0	0	0
Salway	75	0	2	0	2	3
Christiana	75	1	2	1	4	5
Mixed Varieties	100	0	0	0	0	0
Mountain Rose	75	0	0	0	0	0
Total	965	87	47	27	161	17

(5) *Orchard of J. Frank Wilson, Still Pond, Md.*—This orchard lies south of No. 4, in the same field. It was set in 1881; made good growth,

noticed until 1887. That year 488 trees prematurely their fruit and were dug out. In 1888, 435 more became diseased. This orchard is six years old.

(2) An orchard of 30 acres (about 3,000 trees) near Leipsic, Del., owned by John R. Nicholson, contained some diseased trees in 1887. I saw 19 clear cases, and quite a good many trees bore rolled or reddish foliage, and did not look entirely healthy. In 1888 there were 500 diseased trees. This orchard is four years old.

and received the same treatment and care as the other. It began to bear at three years, and has been productive.

Yellows first appeared in 1885 on the south side in one tree of Mountain Rose. That tree was removed, and no other cases have since appeared in the vicinity. The condition of the orchard by varieties is shown in the following table:

TABLE IV.—*Orchard of J. Frank Wilson, Still Pond, Md.*

Variety.	Number of trees planted.	Number removed on account of yellows prior to 1887.	Number diseased by yellows in 1887.	Number diseased by yellows in 1888.	Total dead and diseased.	Per cent. of dead and diseased.
Beers' Smock.....	200	.....	9	6	15	8
Mary's Choice	100	.....	3	1	4	4
Crawford's Late	100	.....	8	4	12	12
Jersey Stump.....	100	.....	3	7	10	10
Reeves's Favorite	150	3	21	7	31	20
Mountain Rose	100	1	.....	3	4	4
Early Rivers	50	4	11	0	15	30
Total	800	8	55	28	91	11

(6) *Orchard of F. H. Harper, Still Pond, Md.*—Examined August 8 and 10, 1887. Re-examined August 6, 1888 (see Map II). This orchard is on the north side of the farm, along the highway, on nearly level up-land, about 4 miles northeast of the village and 1 mile from Sassafras River. The trees were set in 1881; have made an excellent growth, and were a source of pride to their owner, who has cared for them with diligence. The orchard has been productive. In 1886 it bore heavily.

Yellows first appeared in 1886, in four trees in the extreme northeast corner. These were not removed. The orchard contains about 3,000 trees, of which number 314 were found diseased in 1887 (see Map II). Many of these trees bore the spotted, prematurely ripe peaches; others were barren. The limbs of some were grown up quite thickly with the diseased shoots; others bore few such shoots. None of the trees, and not even any of the large limbs, were yet dead, and in most instances the spring foliage was of full size and good color. The last statement also applies to the trees which became diseased in 1888. This orchard, like No. 14, was of special interest because the trees were very thrifty, and yellows appeared in them without any complications due to borers, aphides, or other injuries. The effects which I saw were clearly attributable to one disease.

The following table shows the loss by varieties:

TABLE V.—*Orchard of F. H. Harper, Still Pond, Md.*

Variety.	Number of trees planted.	Number gone, 318 of which were removed in 1887 on account of yellows.	Number diseased by yellows in 1888.	Total dead and diseased.	Per cent. of dead and diseased.
Variegated Free.....	53	17	9	26	49
Crawford's Early.....	107	40	9	49	46
Reeves's Favorite	107	23	27	50	47
Old Mixon.....	260	38	61	99	39
Christiana.....	289	41	21	62	21
Crawford's Late (some Harker's Seedlings mixed in).....	406	60	40	100	25
Mary's Choice (some Harker's Seedlings mixed in).....	335	17	11	28	8
Beers' Smock.....	666	65	73	138	21
Harker's Seedling (five rows), Mountain Rose (two rows), and a few Reeves's	368	54	29	83	23
Susquehanna or Brandywine	216	25	10	35	16
Smock and a few Crawford's Early	156	25	11	36	23
Total	2,963	405	301	706	24

(7) *Orchard of William Shalleross, Locust Grove, Md.*—Examined August 2, 1887; re-examined August 4, 1888. This orchard is on fertile upland about 1 mile from the south bank of the Sassafras River and 3 miles east of No. 6. It contains about 1,600 trees; was set in 1881, and until recently has received careful attention. The trees have not been exhausted by overbearing.

In 1887, this orchard was affected with yellows from one end to the other, fully one-half the trees showing marked signs of the disease, and only here and there one bearing full-grown, dark-green foliage. Many of the trees are stunted, and I am inclined to think root aphides had been at work, though I did not observe them. In fourteen rows on the north side of the orchard scarcely a tree was exempt from the disease. The leaves were scattering, small, and yellowish, and many trees bore plentiful growths of the wiry witchbrooms. The crop of 1886 prematurely bad. In 1887 most of the trees were barren. I saw only here and there a peach, but all of these were premature. As a whole, the south part of the orchard looked healthier than the north part, in which Mr. Shalleross says the disease appeared when the trees had been set only two years. This orchard is practically ruined, and for this reason received little attention in 1887. In 1888 the whole crop prematurely. There remained only thirty-seven healthy trees, nearly all of those which were healthy in 1887 having become badly diseased.

(8) *Orchard of William Hudson, Clayton, Del.*—Examined October 5 and 6, 1887; revisited in August, 1888, but examined only in part. This orchard is on the north side of a fertile farm, lying midway between Clayton and Smyrna. The trees were set in 1880, and made good

growth. They have received yearly cultivation and other necessary attention.

Mr. Hudson thinks there were some diseased trees in this orchard when he moved upon the place in the spring of 1883, but says he harvested from it two good crops of peaches, *i. e.*, in 1883 and 1884. Two years ago he observed many "prematures," and last year (1887) it seemed as if all the peaches in the orchard were premature.

Beginning on the south side, I went through this orchard by double rows, carefully inspecting each tree. In all there were 3,520 trees, including missing ones and stumps to the number of one hundred or more. Of this total, 2,616 were diseased by yellows, about forty of the trees being entirely dead. In other words, three fourths of all the trees in this orchard were diseased. Mr. Hudson's own estimate prior to the examination was three-fifths. Many of these trees were badly affected and ready to die (see Photo XI). The largest number of diseased trees found in any full double row of 160 trees was 142, and the least was 105. The record beginning on the south side of the orchard, is as follows:

TABLE VI.—*Orchard of William Hudson, Clayton, Del.*

Variety.	Double row.	Number of trees.	Number found diseased by yellows in 1887.	Percent. of dead and diseased.
Mountain Rose, includes thirty-three trees of Late Heath Cling.	1	124	100	76
	2	124	89	
	3	124	84	
	4	124	80	
	5	124	93	
	6	152	111	
	7	160	130	
	8	160	142	
York's Early and Troth's Early.....	9	160	137	85
Crawford's Early (three rows).....	10	160	127	79
Moore's Favorite and Variegated Free (seven rows).	11	160	131	75
	12	160	117	
	13	160	115	
	14	160	113	
Reeves's Favorite	15	160	106	66
Pullen's Seedling (three rows) and Crawford's Late (five rows).	16	160	108	75
	17	160	123	
	18	160	126	
	19	160	120	
	20	160	105	
Ward's Late Free (three and one-half rows) and Beers' Smock (one-half row).	21	119	77	65
	22	104	68	
	23	91	63	
	24	78	64	
	25	61	49	
	26	36	27	
	27	19	11	
Total	3,520	2,616	74

In 1888, this orchard bore a small crop of peaches, but most of them were premature, insipid, and small.

(9) *Orchard of John Hudson, Clayton, Del.*—Examined October 7, 1887; re-examined August 14, 1888. This orchard is 1 mile northwest of Clayton, on nearly level sandy loam. It was set in the spring of 1883, for the most part on ground which had previously been in peaches. The old orchard was removed eight years before this one was set, the land, meanwhile, being two years in pasture and the rest of the time in corn, wheat, etc. A triangular portion on the south side was never before in peaches, and this ground is said to have been in pasture previous to planting. There is a slight rise on the southwest side, but not over 8 feet. No part of the orchard is wet. I could see no difference in any part, either as to quality of soil or kind or quantity of weeds. Mr. Murphy, the tenant, says he observed the disease in this orchard in 1886. It existed previous to that date in an old orchard on the same farm. In 1888 this orchard prematurely badly. The following table shows the condition of the orchard by varieties:

TABLE VII.—*Orchard of John Hudson, Clayton, Del.*

Variety.	Number of trees planted.	Number diseased by yellows in 1887.	Number diseased by yellows in 1888.	Total diseased up to date.	Per cent. of diseased.	Remarks on condition in 1887.
Mountain Rose	192	32	36	68	35	
Old Mixon (?)	192	35	51	86	45	
Stump (?)	192	47	63	110	57	
Reeves' Favorite...	192	23	23	46	21	
Crawford's Late (?)	192	43	52	95	49	
Smock	160	30	58	88	55	
Stump (?)	96	22	19	41	43	
Beers' Smock.....	80	27	22	49	61	
Christiana (?)	180	73	30	103	57	
Smock and some other yellow sort.	47	15	12	27	57	
Total	1,523	347	366	713	47	

(10) *Orchard of J. Frank Denney, Leipsic, Del.*—Examined September 9 and 10, 1887. This orchard is about 1 mile northwest of Leipsic, and 4 miles from Delaware Bay, on level, fertile soil. The trees were set in the spring of 1881, and grew very thriftily, so that four years ago the orchard was acknowledged to be the finest in the neighborhood. It received careful attention, being cultivated frequently each year until July. The orchard has not been exhausted by overbearing. It bore a few peaches in 1884, about 200 baskets in 1885, 3,200 in 1886, and none in 1887.

Yellows may have appeared in 1884, but was first noticed in 1885, in a few trees in two groups on the east side of the orchard (see Map III).

Some of these trees were removed. In 1886 many trees became affected, and many peaches ripened prematurely, particularly on the north end of the orchard. Many of these trees were pulled out, but not all of them. In 1887 the disease spread rapidly, involving nearly all the remaining healthy trees (see Map III). At the time of my visit Mr. Denney was thoroughly discouraged, and talked of cutting down the entire orchard. Having harvested one moderate crop he thought if he removed the trees at once and put the ground to other uses the debit and credit of the orchard would very nearly balance. Many of the trees were very yellow and presented a most miserable languishing appearance. The following table exhibits more completely some of the results of my examination:

TABLE VIII.—*Orchard of J. Frank Denney, Leipsic, Del.*

Variety.	Number of trees planted.	Number gone, chiefly on account of yellows.	Number found diseased by yellows in 1887.	Per cent. of dead and diseased.
Mountain Rose	300	96	184	90
Foster	200	100	83	92
Crawford's Early	200	95	84	90
Reeves' Favorite	300	49	195	81
Stump the World	200	70	114	92
Pullen's Seedling	200	70	112	91
Moore's Favorite	200	81	79	80
Crawford's Late	300	45	203	83
Steven's Late Rare-ripe	200	42	128	85
Beers' Smock	*46	7	30	80
Total	2,146	655	1,229	88

*There were 300 trees of this variety, but for want of time only 46 were examined. Those not examined appeared to be equally diseased.

(11) *Orchard of William R. Morris, Dover, Del.*—Examined September 26, 1887. This orchard, of 12 to 15 acres, is on thin, sandy land, about 1 mile south of Dover and 20 or 30 feet above St. Jones' Creek, which surrounds it on three sides. The trees were set in the spring of 1880. This orchard received careful attention and thorough cultivation each year. It has also received great quantities of chicken bones and some commercial fertilizers, but has never returned much in the way of peaches.

Yellows first appeared in 1885, or possibly in 1884, in a few trees. Up to this date the orchard presented a healthy appearance, although it had not made a large growth. In 1886 the disease spread rapidly, and in 1887 I found nearly all the trees affected, at least three-fourths of them. The foliage of this orchard was of a sickly reddish or yellowish green and was much dwarfed, as were also the terminal shoots. The orchard was also suffering from root-aphides.

Some trees were gone, and the young ones which had that spring been set in their place were diseased in the same way, as were a few trees in the neighboring, otherwise thrifty, orchard of 10 acres or more, also set that spring (see Photo. VI, which well represents the appearance of these young trees).

(12) *Orchard of William Brothers, Dover, Del.*—Examined September 16, 1887. Re-examined August 16, 1888. This orchard is on mellow loam, such as one would naturally select for a peach orchard. It is $3\frac{1}{2}$ miles west of Dover. The trees were set in the spring of 1884, received careful attention, and made a good growth.

Yellows first appeared in 1887, and none of the trees were then badly diseased. The following table shows the condition of the orchard by varieties:

TABLE IX.—*Orchard of William Brothers, Dover, Del.*

Variety.	Number of trees planted.	Number diseased by yellows in 1887.	Number diseased by yellows in 1888.	Total diseased.	Per cent. of diseased.
Amsden's June.....	50	2	7	9	18
Early Alexander.....	50	5	7	12	24
Early Rivers.....	50	0	4	4	8
Old Mixon.....	50	0	2	2	4
Reeves' Favorite.....	50	0	1	1	2
Mixed varieties, chiefly Stump the World.....	74	3	*6	9	12
Chinese Cling.....	25	0	3	3	12
Crawford's Late.....	350	6	13	19	5
Salway (?) Probably Beers' Smock.....	50	11	10	21	42
Bilyeu's October.....	25	0	0	0	0
Beers' Smock.....	250	0	1	1	0.4
Total.....	1,024	27	54	85	8

* Mostly smock.

(13) *Orchard of M. Hays, Dover, Del.*—Examined September 24, 1887. Re-examined August 19, 1888. This small orchard stands near the west side of the highway one-half mile south of Dover. It contains 220 trees, which were selected with great care for family use. They were set in the spring of 1884, and have received particular attention.

Yellows first appeared in 1887. The orchard was barren when examined, but no less than 36 trees, 16 per cent., bore the diseased shoots, although none of them were then badly affected. In 1888 I found 47 additional cases, *i. e.*, 26 per cent.

(14) *Orchard of James W. Green, Magnolia, Del.*—Examined September 5, 14, 17, and 19, 1887. Re-examined August 17 and 18, 1888. This orchard stands on level, fertile land, on the east side of the highway, about 7 miles south of Dover, and a mile or two west of Magnolia. This orchard was set in the spring of 1882, with trees procured in the neighborhood. During the first three years it was cultivated in corn, and

since then has been tilled without crops. It received great care, grew thrifitly, and became a source of much gratification to the owner, who expected to receive many crops therefrom. Owing to its unbroken rows and clean thrifit growth it specially attracted my attention. In fact I did not see a finer orchard anywhere in Delaware. It contains about 33 acres, to 30 of which I paid special attention (see Map IV). This orchard is situated in the heart of a very productive peach region, but has never exhausted itself by overbearing. It bore no peaches the third year, only 1,500 baskets the fourth year, none the fifth year, and only from 1,500 to 2,000 in 1887, quite a good many of which were premature. The healthy trees bore a good crop in 1888.

Yellows first appeared in 1886, in a few trees only. Mr. Green says four trees, near each other on the west side, had been sickly for several years. In 1886 he dug about them and made longitudinal slits in the bark of the trunks, and early in the spring of 1887 cut back two of them to the stump. The stumps of these two trees sent out nothing but the diseased shoots, which grew up into a tufted mass. One of the other two trees also showed the disease. From a very careful examination I am inclined to think some of the trees on the east side of the orchard may also have been affected in 1886, and been overlooked because the orchard was barren. However, I am confident that not more than ten trees in the whole orchard could have been so diseased in 1886, and probably not that number. Even the four trees mentioned by Mr. Green as sickly were not known to have the yellows, and one of them certainly did not have it, for it was healthy in 1887. The condition of the orchard by varieties, exclusive of 250 Amsden's June not critically examined, is shown in the following table:

TABLE X.—*Orchard of James W. Green, Magnolia, Del.*

Variety.	Number of trees planted.	Number diseased by yellows in 1886 and 1887.	Number diseased by yellows in 1888.	Total diseased.	Per cent. of diseased.
Beers' Smock.....	353	77	51	128	36
Wilkins' Cling.....	155	14	15	29	19
Fox's Seedling.....	109	2	14	16	15
Christiana.....	211	4	3	7	3
Crawford's Late.....	729	37	82	119	16
Old Mixon.....	171	2	17	19	11
Stamp the World.....	374	25	46	71	19
Reeves' Favorite.....	264	12	23	35	13
Crawford's Early.....	210	26	28	54	26
Troth's Early.....	346	61	35	96	28
Total.....	2,922	260	314	574	20

(15) *Orchard of D. P. Barnard, Rising Sun, Del.*—Examined September 7, 1887. Re-examined August 21, 1888. This orchard stands on warm, sandy loam, on the east side of the highway, in a great peach region,

and not more than one-half mile from the celebrated "Ashcraft" farm. It contains about 25 acres, but only the west part was examined. The trees were set in the spring of 1885, and have received yearly cultivation in corn and tomatoes, fertilizers being used. The orchard first bore peaches in 1888.

Yellows first appeared in 1887, chiefly in six rows on the west side (see Map V). Out of about 1,000 trees 34 were diseased. East and southeast of this orchard, on the same farm, stood two other orchards, both of which became quite badly diseased in 1886 or earlier.

(16) *Orchard of Dr. Henry Ridgely, Dover, Del.*—Examined September 23, 1887. This orchard is on deep, fertile sandy loam, at Cowgill's Corners, 4 miles east of Dover and 3 miles from Delaware Bay. It was set in the spring of 1855, and originally contained about 2,000 trees. It received careful and often prolonged cultivation each year, and has been a very productive orchard, but has never received much return in the way of fertilizers. During the thirty-two years quite a good many trees had disappeared from effects of injury by freezing, by over-bearing, by borers, etc., but yellows did not appear until 1877, and then in a few trees only. These were dug out and removed. Each year since then the disease has appeared in some trees, and each year they have been removed. It is not possible to determine exactly how many trees have been taken out on this account, but certainly a number of hundred. In 1887 the disease attacked more trees than any previous year, and these were standing at the date of my visit. Out of the original 2,000 trees I estimated that 800 were remaining, and of this number at least 500 were then entirely free from yellows, and appeared likely to continue productive for another ten years if not molested by that disease.

(17) *Orchard of Joseph McDaniel, Dover, Del.*—Examined September 27, 1887. Re-examined August 20, 1888 (see Map VI). This orchard stands on the southwest side of the highway, 2 miles northwest of Dover. The nearly level field consists of light sand or loam, worn out thirty years ago and brought back to a state of fertility by recent very heavy manurings. The orchard has also received commercial fertilizers. It was planted in the spring of 1884. It received careful culture; made a thrifty growth; and bore no peaches until 1888, when it was planted to corn.

When first examined, those trees not diseased bore full-grown, healthy foliage, and in every way appeared to be vigorous. The tops of many of the diseased trees were also of a healthy green, indicating recent disease. Some of the trees in this orchard probably became diseased in 1886, but did not attract attention. Most of them, undoubtedly, first became affected in 1887. Out of about 1,800 trees, 504 were diseased, the greater number being on the southeast side of the orchard (see Map VI on which the arrow points south). Photographs I and II are of shoots taken from this orchard. On the limbs of many trees were numerous pale, feeble shoots.

In 1888, 383 out of the remaining 1,300 trees became diseased.

(18) *Orchard of Dr. W. S. Maxwell, Still Pond, Md.*—Examined August 14, 1887. Re-examined August 7, 1888 (see Map VII). This or-

chard was set in 1885 and 1886. It lies south of No. 1, at the foot of a high hill on which are also diseased orchards. The soil of the "bottom" is deep, mellow loam, which receives the drainage of the hill and is fertile. The higher parts of the orchard contain more clay. In 1887 it was cultivated without a crop. In 1888 it was planted in corn, both trees and corn making a vigorous growth, especially in the low part. The outer four rows of trees on the east side are one year younger. None of these are diseased by yellows, but some on the south end are badly "Frenched" (see Photo. XXVII).

The orchard bore fruit this year for the first time (sparingly), but some of the trees blossomed last year, and set a peach or two. The trees which I found diseased in 1887 were all in the southwest corner. None bore fruit; some looked yellow, and some had put out a scanty, wiry, branched growth from the stock near the earth or from the top, or in both places.

In August, 1888, 45 per cent. of the older trees, previously healthy (!), showed unmistakable evidence of the yellows, either in premature fruit or diseased shoots, or in both.

EXTENT OF THE PEACH INDUSTRY IN THE UNITED STATES.

The peach is, by common consent, the choicest fruit of middle latitudes, and is cultivated in both the north and south Temperate Zones the world over; but nowhere else in such enormous quantities as in the United States. Notwithstanding this, since facilities for drying and canning on a large scale have become general, there is a demand for the entire product of even the most prolific years, and indirectly the industry has thus become one that interests all parts of the country.

The districts of the United States and Canada now chiefly interested in the production of this fruit are the following: Southern Connecticut, southeastern New York and western New York, southern Ontario, New Jersey, eastern Pennsylvania, Delaware, Maryland, middle Georgia, Tennessee, northern Ohio, southwestern Michigan, southern Illinois, southern Kansas, parts of Missouri, Arkansas, and Texas, and nearly all of California. The accompanying map (IX) will indicate these areas more definitely. This map also shows the area north of which peaches are an uncertain crop, owing to the severity of the winters, and also that area south of which they are not much grown for commercial purposes, owing to the moisture and heat of the climate or to the long distance from large markets. The areas of greatest productivity lie (1) along the Atlantic coast between New York and Norfolk and (2) on the Pacific slope in California. The accompanying map also roughly indicates the present distribution of peach yellows in the United States and Canada, so far as known.

The total peach product of the United States, as determined by the Tenth Census, was never published and can not now be ascertained. But though it can not be determined for the whole country, it can be de-

terminated approximately, and for a series of years, for the Delaware and Chesapeake peninsula, which has been one of the most productive areas. The following table gives the shipments over the Delaware Division of the Philadelphia, Wilmington and Baltimore Railroad for a series of years; and if one third be added for years prior to 1880, and one-half for years following, to make up for peaches dried, canned, and consumed on the peninsula, or marketed by water, the total will very nearly represent the actual product of the entire peninsula, or at least will not be in excess of that product.

TABLE XI.—*Peach shipments from the Delaware and Chesapeake Peninsula over the Philadelphia, Wilmington and Baltimore Railroad.* (Copied from office records by permission of Superintendent I. N. Mills, Clayton, Del.)

Year.	Baskets (five-eighths bushel).	Year.	Baskets (five-eighths bushel).
1867.....	1,086,530	1880.....	1,708,500
1868.....	12,267	1881.....	270,500
1869.....	2,143,467	1882.....	2,731,770
1870.....	1,443,733	1883.....	1,783,477
1871.....	2,668,800	1884.....	1,936,617
1872.....	2,181,867	1885.....	1,870,496
1873.....	1,521,600	1886.....	1,099,738
1874.....	675,200	1887.....	848,378
1875.....	4,536,000	1888.....	3,177,477
1876.....	1,058,500	Total for twenty-two years.....	
1877.....	2,001,500		
1878.....	434,500		
1879.....	2,105,500		

VALUE OF PEACH PRODUCTS.

Skill and industry are required in peach growing. Not every man who sets an orchard becomes a successful peach-grower. There are many obstacles to be overcome, and failures are not infrequent. Nevertheless, in the peach districts no other crop can be grown with anything like the same amount of profit. Many farmers have become rich in the business, and very often a comparatively small peach orchard has yielded a larger money return than all the rest of the farm. Some idea of the profits of successful peach growing may be gained from the following statements :

A 70-acre orchard belonging to James Hurdd, of Locust Grove, Md., and now nineteen years old, has borne twelve crops at an average yearly value of about \$6,000.

An orchard of 2,700 trees owned by Thomas D. France, of Chestertown, Md., is said to have netted its former owner over \$40,000. The trees are between twenty-one and twenty-six years old and appear to be healthy enough to bear peaches for another five years.

During a series of years the tenant on the Ashcraft farm, near Magnolia, Del., made enough out of his share of the peach crop to buy a

valuable farm of his own. The same is true of the tenant on the neighboring McBride farm, and is true also of other tenants in Maryland and Delaware.

In 1874, Dr. Henry Ridgely, of Dover, Del., paid \$11,000 for the Slaughter farm, southwest of Dover. This was over \$70 an acre and was at that time considered an exorbitant price. Between 1874 and 1887 this farm yielded over \$30,000 worth of peaches. The orchard also bore a large and valuable crop in 1888. To say nothing of other products, this farm has paid for itself in peaches alone three times over in fifteen years. On this farm in 1889 the product of 16 acres of early peaches, then three years old, sold for over \$1,800.

Dr. Ridgely kindly furnished me with records from other farms which are of equal interest.

About twenty-five years ago he raised 30 acres of fine wheat, which he sold for \$2,800. The same year from 10 acres of Troth's early peaches he realized nearly \$2,600, *i. e.*; over \$250 per acre.

In 1863, 1864, or 1865 (he is now uncertain which year), the peach crop from his Cowgill's Corner farm sold for \$1,260, *i. e.*, \$213 per acre, although some peaches were lost by the equinoctial storm.

In 1873, from 70 acres of peach orchard, he sold peaches to the amount of \$10,200, although the Early Yorks, which were very fine and hung full, were all lost by a cloud-burst or very heavy rain-fall. That year one tree bore \$20 worth of peaches; another tree, \$25 worth; and a third tree, \$26.50 worth. From this third tree, by mistake, the men picked 15 baskets of green fruit two weeks too soon, and this was lost. But for this accident a single tree would have produced over \$30 worth of fruit.

In 1884, from 400 trees (4 acres) of Fox's Seedlings, he realized \$820; *i. e.*, \$205 per acre. This fruit was sold in four days, the highest price paid for any of it being 65 cents per basket.

T. C. Crookshank, of Cecilton, Md., sold \$1,200 worth of peaches in 1886 from 12 acres.

Richard Hollyday's orchard of 30 acres in Spaniard's Neck, set in 1866, netted him an average of \$30 per acre for ten consecutive years. The trees were dug out at the age of twenty, having borne for about sixteen years.

From the farm of William Hudson, near Clayton, Del., \$16,000 worth of peaches were sold in the two years 1883 and 1884, the orchards at that time containing about 100 acres.

In 1870, according to William Parry, a Middletown, Del., peach-grower, formerly from New Jersey, cleared \$38,000 from 400 acres of peaches. Mr. Parry also declared that he could name several fruit-growers who in 1869 sold from 20,000 to 60,000 baskets each, at a clear profit of from \$10,000 to \$30,000.¹ He is also authority for the statement that the Peach Blossom farm in Maryland, which sold some years prior to 1871 for \$31,000, yielded the buyer the first season peaches

¹ *Proceedings of the Pennsylvania Fruit Growers' Society*, 1871, pp. 47, 48.

enough over and above all expenses of picking and marketing to entirely pay for the farm.

Mr. Parry's conclusion is that "so far as peach growing on a large scale is concerned, the net profits may very safely be set down at from \$100 to \$175 per acre, while in many instances they yield right through from \$175 to \$250 per acre".¹ If gross profits be substituted for "net profits," this conclusion does not differ materially from my own. It relates, of course, to bearing years.

The profits of large orchards *for a series of years* have in some instances been very remarkable. I cite two cases:

TABLE XII.—*Orchard of E. C. Fenimore, Odessa, Del., 100 acres.*²

Year.	Baskets.	Value.
1851 (first crop; orchard two years old).	191	\$206.24
1862.	1,834	868.34
1863.	18,423	15,051.81
1864.	25,964	18,443.98
1865.	22,124	23,070.45
1866.	13,675	20,266.07
1867.	27,500	18,551.40
1868.	4,250	15,281.68
1869.	34,000	14,464.27
1870.	16,020	15,607.76
1871.	19,600	6,432.55
1872.	6,957	2,931.61
1873.	1,420	1,341.83
1874.	674	696.35
Total, fourteen years.	192,718	162,224.14

This is equivalent to an average annual return of \$116 per acre for fourteen years.

TABLE XIII.—*Orchard of Col. E. C. Wilkins, Chestertown, Md., 325 acres.*³

Year.	Gross receipts.
1862 (orchard planted four years)	\$12,600.00
1863.	32,340.00
1864.	32,399.00
1865.	48,042.98
1866.	16,804.00
1867.	9,989.00
1868.	1,350.00
1869.	30,429.00
1870.	22,000.00
Value of brandy made during these nine years.	15,150.00
Total.	231,043.98

¹ *Proceedings of the Pennsylvania Fruit Growers' Society*, 1871, pp. 49, 50.

² Copied from the yearly record by permission of Mr. Fenimore.

³ *The Horticulturist*, N. Y., 1871, p. 308.

Michigan peach orchards are not less profitable than those of the Atlantic coast.

About 1868, in a letter to D. A. Winslow, George Parmelee stated that in 1865, on his Berrien County farm, "forty-five early Crawford trees produced a few baskets over 1,100 [peck (?) baskets] and sold for \$2 per basket, amounting to \$2,200. The trees were 20 feet apart each way, which puts 109 trees on an acre, and makes the yield at the rate of \$5,848 to the acre. This, of course, is given as an extreme result, but if any man thinks that peach-growing in this region is not profitable, let him call on our fruit-growers and get facts."¹

In 1865 or 1866, S. F. Heath, of Heath's Corners, Berrien County, Mich., purchased 5 acres of bearing peach orchard for \$1,350. His first crop sold for \$1,800. He then sold the 5 acres to William Gates for \$7,000. Mr. Gates sold his first crop for \$2,000 and his next one, 1868, for \$4,000, and had "good prospects for a greater crop the following year."²

In 1874, after correspondence with one hundred of the largest peach-growers, H. E. Bidwell, of South Haven, Mich., stated the average profit on peaches in Van Buren County, for the three years, 1872-74, to have been \$343.89 per acre, *i. e.*, \$300 in 1872, \$431.68 in 1873, and \$300 in 1874.³

In 1879, George T. Lay, of Allegan County, Mich., sold \$1,000 worth of peaches from less than 4 acres, and another man is said to have sold \$4,700 worth from 10 acres. The average value of the peaches from Mr. Lay's orchard for five years, 1876-80, was \$213 per acre.⁴

At Lawton, Mich., in 1880, the peaches from 10 acres of five-year-old trees sold for \$250 per acre.⁵

I have no data concerning the profits of California orchards, but presume an equally good showing might be made.

VALUE OF PEACH FARMS.

When on the Delaware and Chesapeake Peninsula I made careful inquiry as to the value of peach farms in districts unaffected or but recently affected by yellows. Real estate is dull and sales are slow, but peach farms bring more than any other.

The "Cassiday" or "Peach Blossom" farm, on Sassafras River, in Cecil County, contains about 663 acres, and has been sold several times within the last thirty years, each time for about \$50 per acre. In Sassafras Neck, good farms with buildings are worth from \$40 to \$70 per acre. In some instances offers of \$100 an acre would be refused.

About Chestertown good peach farms are worth from \$70 to \$100 per acre. Plenty could be bought for \$70. Recently, in the upper part of Queen Anne County, a farm brought \$73 per acre at a forced sale, and

¹ *History of Saint Joseph*, by D. A. Winslow.

² *Ibid.*

³ *Annual Report of the Secretary of the Mich. Pom. Soc.*, 1874, p. 511.

⁴ *Ann. Rep. of the Secretary of the Mich. State Hort. Soc.*, 1880, p. 276.

⁵ *History of Michigan Horticulture*, T. T. Lyon, p. 270.

good peach farms will readily bring that sum, while many peach-growers would not sell for less than \$100 per acre.

In Spaniard's Neck the well-established peach farms are worth from \$70 to \$100 per acre. Land at some distance from the river and not well adapted to peaches is worth much less.

The peach farm now occupied by William Hudson, at Clayton, Del., contains 222 acres, and was bought in 1883 at \$130 per acre, 100 acres being in bearing orchard.

Good peach farms, situated within a few miles of Dover, are worth from \$75 to \$100 per acre. A few might be bought as low as \$50 or \$60.

Peach farms in the vicinity of Magnolia are worth from \$75 to \$100 per acre.

DEPRECIATION OF REAL ESTATE DUE TO YELLOWS.

This has been marked in some sections. Real estate is undoubtedly dull the country over, owing to various causes; but that there has been a marked depreciation in values in upper Maryland and Delaware, due solely to the ravages of yellows, can not be denied. It is too patent. In places where the disease has prevailed most destructively it would now be hard to sell a peach farm at any price. Buyers do not care to invest; the risk is too great. Owing to the prevalence of this disease many farms will not now sell for over one-half or two-thirds as much as they would have brought five years ago. In sections where yellows has entirely destroyed the orchards or rendered peach-growing precarious and unprofitable, farms are now worth on an average about one-half what they were formerly.

Farms about Middletown, Townsend, McDonough, and Odessa are now worth from \$50 to \$80 per acre. Fifteen or twenty years ago, when peach-growing was at its height in this section, real estate brought fabulous prices, but usually paid for itself in peaches within a few years.

In October, 1866, near McDonough, 170 acres of poor land, without fences, brought \$120 an acre at public sale.

In 1867 Mr. G. W. Karsner's farm of 300 acres, near McDonough, was assessed at \$150, and valued by some at \$250 per acre. This farm was bought in 1832 for \$14 per acre.

In 1867 a farm of 150 acres, 2 miles east of Odessa, sold for \$199 an acre, and at that time the upland portion (150 acres) of Mr. E. C. Fenimore's farm would undoubtedly have sold for over \$300 per acre. This farm, lying on Delaware River, contains 800 acres, 650 being marsh and the rest sandy upland with red clay subsoil. It was sold in 1832 as part of a tract of 2,800 acres for 93 cents an acre, and again in 1853 to Mr. Fenimore, when its value for peach-growing was understood, for \$25 an acre, marsh and all.

In 1874 the peach farm of Mr. Serriek Shalleross, near Middletown, containing over 1,000 acres, was valued at \$150 per acre.

At about the same time Mr. Shalleross bought three farms to put into peaches, paying \$156, \$127, and \$120 per acre. At that time, about

Middletown and McDonough, land of any sort suitable for peaches sold readily, even without buildings, at from \$100 to \$125 per acre.

The depression of real-estate values in Berrien County, Mich., subsequent to the loss of the orchards was also very great, and many persons were financially ruined, but I have not enough data to render it worth while to consider it at length. During the flush peach times real estate in southwest Michigan changed hands at prices fully equal to those which prevailed in Delaware.

Should peach yellows sweep away the magnificent orchards of the middle part of the Chesapeake and Delaware peninsula, as it did those of New Castle County, Del., and Berrien County, Mich., the effect, not only on the price of lands, but also on railroad and steam boat traffic and on the general prosperity of the peninsula, must be very great. Growers whose farms are mortgaged would be financially ruined and life would be harder for every inhabitant. This would be true especially of the poorer classes, many of whom are supported almost entirely by the peach industry. The single item of the carrying trade amounts to thousands of dollars annually, as may be seen from the table of shipments by railroad, and this is only one of many items. In a word, the prosperity of nearly every business interest on the peninsula hinges on the peach industry.

That the peach orchards are really in danger of being destroyed must be apparent to any one conversant with the facts, or to any one who will carefully examine the data presented in this report. In the celebrated Sassafras River region, and also in all the upper part of Kent County, Del., there will not in five years be a single productive orchard over six years of age if yellows continues to spread as rapidly as it has done for the last three years. I have no desire to present a sensational or gloomy view, but I give this as my deliberate judgment, after sixteen months' continuous study of the subject, with every opportunity to examine peninsular orchards.

Either of two things may possibly avert this dreaded result:

- (1) The application of some remedy or preventive.
- (2) The disappearance of the virulence of the disease from unknown natural causes.

In my judgment we are already in possession of knowledge available for a partial suppression of the disease, but, from a wide acquaintance with the peninsular peach growers and some knowledge of human nature, I am inclined to think it can be reduced to practice only in sections but recently invaded, *i. e.*, toward the lower part of the peninsula (see Prevention).

IV. CONDITIONS KNOWN OR SUPPOSED TO FAVOR THE DISEASE.

CLIMATIC CONDITIONS.

THE NON-ADAPTATION OF THE PEACH TO OUR CLIMATE.—From the foregoing section upon history and distribution, and especially from that part devoted to the early history of the peach in the United States, it must be apparent that portions of this country are well suited to this fruit. Otherwise it never could have gained such an early strong foothold or flourished in the open air unprotected as it has done.

The peach is undoubtedly of Asiatic origin, but neither in China nor on the table-lands of Persia does it appear to be more at home than in parts of the United States; and this might be expected from the fact that we are in the same zone and under climatic conditions not markedly different from those existing in the middle latitudes of Asia.

From the recent suggestion by Professor Budd,¹ and the earlier one by Dr. Emerson,² that yellows may be a disease of non-acclimatization, it is worth while to inquire (1) what constitutes acclimatization? (2) what indicates that Asiatic peaches are hardier than our own?

It ought not to be difficult to determine whether a cultivated tree takes kindly to a climate. I know no more certain proof than that it makes a vigorous growth, is productive, attains the usual longevity of its species, and is capable of maintaining itself to a considerable extent outside of cultivation, in fence-rows, hedges, and other neglected places. In the more favored parts of this country the peach fulfills all these conditions, and has done so far for more than two centuries. In my examinations on the Delaware and Chesapeake peninsula in 1887 and 1888 I saw at least fifty orchards of ages ranging from twenty to thirty years, and I saw a few still older. Such orchards are by no means infrequent, except where yellows has prevailed for a long time. Even in the relatively severe climate of Michigan orchards have lived twenty-five and thirty years. The *average age* of the orchards in Maryland and Delaware is only about sixteen years, but this is to be attributed to over-production and neglect rather than to climate. If our trees were pruned as carefully as European trees they would undoubtedly live as long. Even without special care they sometimes reach a great age. There are well-authenticated cases on the Atlantic coast of peach trees which have lived forty or even fifty years, and George Thurber mentions one in Virginia which reached the age of seventy years.

That Chinese peaches are more hardy than our own is a belief rather than a well-established fact. They are certainly inferior in flavor and probably not hardier than the commonly cultivated "Persian" sorts. I have myself this year seen well-marked yellows in North China peaches growing in Delaware, and have no doubt that Chinese peaches will prove subject to all the diseases incident to other races, and on *a priori*

¹ *Popular Gardening*, Buffalo, N. Y., July or August, 1888.

² *Proc. of the Am. Pom. Soc.*, 1869.

grounds, in the absence of sufficient well-authenticated information, I have no doubt that in China itself they are subject to various diseases, especially where grown in quantity. Certain, at least, is the fact that in the North Island of New Zealand the peach has been nearly exterminated within the last ten years by some mysterious blight.

Nevertheless, with some show of reason, peach yellows has been attributed to various unfavorable climatic conditions. The relation of these conditions to yellows will, therefore, be discussed in the following pages. Four theories have received most frequent mention by writers on this subject, and as no proofs or valid arguments have been advanced in favor of any others it will be sufficient to restrict attention to these four, with a view to determine, if possible, just what relation these supposed causes bear to the disease.

SUPPOSED GENERAL CHANGE IN CLIMATIC CONDITIONS.—This theory may be dismissed with a word or two. It is easy to propound and difficult to establish. In reference thereto it may be said: (1) There is no evidence of any marked change in the climate of the United States during the last one hundred years; and (2) if there were, there is no evidence that the outbreaks of peach yellows have conformed to any such change. We may, therefore, set aside this theory until evidence is adduced in proof of both propositions.

EARLY AUTUMN FROSTS.—This theory has been urged with more show of reason. When we reflect upon the function of the leaves, and on the nice balance between roots and foliage which is necessary for the health of a growing tree, it is evident that any premature destruction of the foliage must not only affect the maturing wood, but also more or less seriously injure the whole plant. With this fact in mind, I have given careful attention to the subject, the more because some very considerable authorities in horticulture have favored this theory, and have stated by way of proof that this disease never occurs in the South or when the peach is grown under glass.

After careful inquiry my conclusion is that early frosts have nothing whatever to do with yellows. This conclusion is based, in part, upon the following facts:

(1) In the peach districts of Michigan severe frosts sometimes occur in August and often in September, *i. e.*, before the leaves have fallen; yet there are localities where peach trees have been grown continuously for thirty years, and where yellows has not yet appeared.

(2) In the region of the Great Lakes early frosts have not been confined to recent years, yet peach yellows did not appear there until quite recently, *i. e.*, in southwestern Michigan in 1866; in northern Ohio in 1878; in Ontario in 1876.

(3) On the shore of Long Island Sound, in the vicinity of New Haven, Conn., peach yellows was very prevalent between 1831 and 1846; yet, during the entire period of sixteen years, at Middletown, in the interior

of the State but not far removed, there was but one severe frost as early as September. The record for twenty-four years is as follows:

TABLE XIV.—*Autumn frosts at Middletown, Conn. Latitude 41° 33' 8''.*

[From the meteorological record kept by J. Barrat, M.D.¹]

Year.	First severe frost.	Year.	First severe frost.
1831...	November 4.	1843...	October 15.
1832...	October 29.	1844...	October 2 and 21.
1833...	(?) [*]	1845...	October 16.
1834...	October 10.	1846...	October 20.
1835...	October 26.	1847...	October 12 and 16.
1836...	September 30.	1848...	September 30.
1837...	October 5.	1849...	November 1.
1838...	October 8.	1850...	October 14.
1839...	October 5.	1851...	September 25.
1840...	October 16.	1852...	October 16 and 17.
1841...	October 14.	1853...	(?)
1842...	October 7.	1854...	October 21.

* First light frost September 14.

(4) On the upper part of the Delaware and Chesapeake peninsula peach yellows has appeared within the last three years in a great many young orchards, often affecting hundreds of trees in a single orchard in one year. In 1887 and in 1888 I saw it repeatedly in trees set only three or four years, and occasionally in still younger trees, most of which were healthy in 1887. In connection with these facts I made inquiries to determine (1) the exact dates at which early frosts have occurred in recent years, and (2) whether usually, or occasionally, the peach is liable to lose its foliage prematurely, *i. e.*, while its buds and wood are immature. In 1887 and 1888 I supplemented these inquiries by observations of my own.

At Dover and Clayton weather records have been kept for a number of years, and these show that there have been no severe early frosts, certainly none that serve in the least to explain the sudden widespread devastation of the orchards by yellows. Below is a synopsis from these records:

¹ *Trans. of the Conn. State Agric. Society, 1854, p. 131.*

TABLE XV.—*Autumn frosts at Dorer, Del. Latitude 39° 11'.*

[From a continuous record by John S. Jester. Observations at 5 a.m., 12 m., 2 p.m., and 9 p.m. The thermometer is exposed at about 5 feet from the ground. In low places in orchards the temperature would be a few degrees lower.]

Date.	Lowest temperature.	Remarks.	Date.	Lowest temperature.	Remarks.
1885.	<i>Degrees.</i>		1887.	<i>Degrees.</i>	
Aug.	46	No frosts.	Aug.	50	No frosts.
Sept. 24..	40	First frost, light.	Sept.	46	Do.
Oct. 7....	40	Frost.	Oct. 13...	40	First frost, light.
Oct. 10...	38	Do.	Oct. 14...	42	Light frost.
Oct. 11...	40	Do.	Oct. 15...	34	Hard frost.
Oct. 22-26	38-40	Five frosts.	Oct. 16...	30	Do.
Oct. 31...	38	Frost.	Oct. 22..	40	Light frost.
Nov. 1...	36	Do.	Oct. 23...	32	Hard frost.
Nov. 16..	31	Do.	Oct. 31...	34	Do.
Nov. 22..	32	Temperature first reached freezing.	Nov. 1...	42	Light frost.
1886.			Nov. 2...	28	Hard frost.
Aug.	52	No frosts.	Nov. 3 ..	38	Light frost.
Sept. 20..	38	First and only frost, light.	Nov. 5...	32	Hard frost.
Oct. 2....	36	Light frost.	Nov. 6...	26	Do.
Oct. 3....	38	Do.	Nov. 9 ..	32	Do.
Oct. 4....	40	Do.	Nov. 10..	40	Light frost.
Oct. 17...	30	Hard frost.	Nov. 11..	34	Hard frost.
Oct. 22...	38	Frost.	Nov. 12..	40	Light frost.
Nov. 5...	32	Freezing weather set in.	Nov. 13-14		Two hard frosts.
			Nov. 18-23		Six hard frosts.
			Nov. 28-30		Three hard frosts.

TABLE XVI.—*Autumn frosts at Clayton, Del. Latitude 39°* ——.

[From records kept in the office of the superintendent of the Delaware division of the Philadelphia, Wilmington and Baltimore Railroad. Observations at 6.30 to 7.30 a. m., 9 a. m., 12 m., 3 p. m., 5 or 6 p. m., and 7.30 to 9 p. m. Sunday records of temperature mostly wanting. Metallic box thermometer exposed at north window about 7 feet from ground.]

Date.	Lowest temperature.	Remarks.	Date.	Lowest temperature.	Remarks.
1885.	<i>Degrees.</i>		1886.	<i>Degrees.</i>	
Aug.	51	No frosts.	Oct. 17....	.....	Clear and cool; probably a frost.
Sept. 24...	45	May have been a light frost.	Oct. 22...	44	Clear; probably a frost.
Oct. 10...	40	First hard frost.	Nov. 5...	33	Judging from temperature records, freezing weather set in at this date.
Oct. 22-28	38-44	Seven hard frosts.			
Nov. 11...	36	Hard frost.	1887.		
Nov. 14...	36	Do.	Aug.	55	No frosts.
Nov. 15...	*36	Clear and very cold.	Sept. 24...	44	Possibly light frosts.
Nov. 16...	32	Clear and cold.	Sept. 25....	.....	Do.
Nov. 17...	32	Do.	Oct. 12...	44	Probably light frost.
Nov. 20...	30		Oct. 13...	47	Frost.
1886.			Oct. 14...	45	Do.
Aug.	63	No frosts.	Oct. 15...	37	Do.
Sept.	54	Do.	Oct. 16....	.....	Do.
Oct. 2...	43	Clear and cool; first frost.	Oct. 22...	40	Probably a frost.
Oct. 3....	.....	Clear and cool; may have been another light frost.	Oct. 23...	.....	Hard frost.
Oct. 4....	.....	Sunday; probably another light frost.	Nov. 2...	32	First ice observed.

*At 6 p. m. †Cloudy and rainy nearly all the rest of the month; temperature 33°-57°.

At Still Pond, Md., the entries in the journal of Dr. W. S. Maxwell agree substantially with the Dover and Clayton records although thermometric readings are not given. A daily record by Dr. Henry Ridgely, of Dover, also agrees substantially with that of Mr. Jester, although not so complete.

From these records it is clear that during the three years 1885 to 1887 there were no frosts in August and none of any consequence in September. In 1885 the first severe frost was on October 10; in 1886 it was on October 17; in 1887 on October 15; in 1888 on October 10.

The first point raised is whether the shoots of the season were in such an immature condition at the time of these frosts as to be seriously injured by loss of leaves, assuming for the sake of argument that the leaf function was entirely suspended after these dates. The second point is whether the severest injuries of this sort can develop peach yellows, or anything resembling it.

In the autumn of 1887 I paid particular attention to the ripening of foliage on deciduous trees, especially on the peach, and to the effects of the October and November frosts. Leaves in some orchards, especially about Chestertown, Md., began to fall in considerable quantities as early as August 25, but this was, I think, abnormally early.

At Dover, in the McDaniel orchard (see Map VI), by September 27 from one-third to two thirds of the leaves on all the lower branches had already fallen, and those remaining on these branches (except the terminal ones) detached very readily when the shoots were seized at the base and drawn gently through the half-closed hand, thus showing that though still green their work was very nearly completed. Some of the smaller branches had already lost all their leaves. The branches on the tops of the trees were yet thickly covered with green leaves, but the buds were well developed and the twigs had an appearance of maturity. On an average the trees in this orchard had lost about one-fourth of their leaves.

At Clayton, in an old orchard owned by Alfred Hudson, and considerably injured by yellows, the leaves had nearly all fallen by October 4. The early varieties sliced first. Smocks and some other late sorts retained quite a sprinkling of green. On many trees in this orchard there was not a leaf, and on an average about four-fifths of all the foliage had fallen. Such was substantially the condition of other bearing orchards examined at that time in that locality. The young orchards were greener. Three days later I found that the trees in the four-year old orchard of John Hudson (No. 9 of this report) had lost from two-thirds to nine tenths of their leaves. On some varieties there were more leaves than on others. A one-year old orchard on the same farm looked very green and retained most of its foliage. This was healthy in 1888, but No. 9 was badly diseased.

On October 8 near Smyrna I examined two orchards, each about three or four years old. They had shed from one-half to two-thirds of their foliage, but the tops of many of the trees were still quite green. From my window at Clayton I could also see another young orchard of many acres. The lower two-thirds of what foliage remained was reddish brown, the upper third was green.

On October 10, near Clayton, in a very thrifty three-year old orchard belonging to John Gault, I found that the trees still retained from one-third to one-half their leaves. Fully one-third were yet entirely green and doing duty. They were entirely gone from some shoots and from the lower one-half to two-thirds of most of the shoots. The ends of many shoots still retained all their leaves, although the buds in their axils would probably have grown if taken for inoculation in August. My memorandum on this orchard was: If frost occurs before October 20 it will catch the terminal leaves, but I question whether the trees will suffer appreciably thereby. On a partial examination at that time I found in this orchard twenty-five trees with yellows, and many additional cases developed in 1888.

Speaking for a majority of the young orchards about Clayton, in which many new cases of yellows appeared in 1888, it may be said that from one-half to three-fourths of the foliage had fallen by October 10, and in older orchards a much larger proportion, although there had been no frost.

Variety, age, situation, kind of fertilization, time and manner of cultivation, and the production of fruit all have much to do in determining how early the leaves shall fall.

In 1887, judging by the number of leaves which had fallen, and by the appearance of the young wood, it is reasonable to suppose that peach trees on the Delaware and Chesapeake Peninsula were well out of harm's way before the first frost. If this is true of 1887, it is undoubtedly true also of 1885 and 1886, and these frosts can not have been the cause of this outbreak of yellows. Indeed, on general principles it may well be doubted whether even very early and killing frosts will produce peach yellows. The burden of proof is all on the side of those who support this theory.

In Washington, D. C., especially where somewhat shaded or protected by buildings, peach trees retained their foliage much longer than in the open field. The first severe frost occurred October 16, at which time many of the trees were yet in nearly full leaf. Between this date and October 30, especially after a heavy rain, the leaves fell rapidly, but were not all gone or all yellow until about November 7, although there were a number of severe frosts.

COLD WINTERS.—The winter of 1880-'81 was unusually severe. On the Delaware and Chesapeake Peninsula in January the temperature fell to 12° below zero F., a very unusual occurrence. The fruit buds were nearly all destroyed. Many trees were killed outright. Thousands more were badly injured and have not recovered to this day. Many persons have attributed the recent alarming increase of yellows to this severe winter. It has also been asserted that in New Jersey and upper Delaware a corresponding increase of yellows followed the severe winter of 1856-'57. In Berrien County, Mich., the increase of yellows was also ascribed to the severe winters of 1872-'73 and 1874-'75.

This theory appears more tangible than the preceding, because the effect of hard freezes is very apparent in injured bark and discolored wood, and because dark heart-wood is not infrequent in trees suffering from yellows. It has been a favorite theory with many writers. They have insisted that yellows is very strictly a disease of northern climates, naturally unsuited to the peach, the fact or supposed fact that the disease did not prevail in middle Delaware or in the Southern States being cited as ample proof of this. Dr. Emerson and Mr. Hovey, in particular, cite the very part of Delaware now badly affected as proof that a mild climate is a safeguard.¹

It is probable that anything which reduces the vitality of a tree will render it more susceptible to disease, and in this way severe winters may have exerted an evil influence; but that any degree of cold, or any sudden change of temperature, can of itself cause peach yellows is, I think, impossible. The following reasons seem to be conclusive:

(1) If peach yellows is due to severe freezes it ought not to have

¹ *Proc. of the Am. Pom. Soc.*, 1869, p. 153; and *Trans. Mass. Hort. Soc.*, 1882, Part I, p. 142.

appeared first in centers of cultivation, but rather on northern border regions, where severe winters are of more frequent occurrence. The whole history of the disease shows the reverse of this to be true.

(2) On such an assumption, peach yellows ought not to appear at all in mild southern climates, yet it has been present for a number of years in Georgia, on nearly the southern limit of the successful culture of the peach, at least of the so-called "Persian" peaches, the only race yet grown to any great extent in this country. In this connection it is also well to remember that the peach is not indigenous to a warm climate, as some writers have taken for granted. It flourishes best in the middle latitudes of either hemisphere, *i. e.*, between the thirtieth and fortieth parallels, and only exceptionally north or south of these boundaries.

(3) During the winter of 1856-'57, at Grand Rapids, Mich., many peach trees were killed to the ground or greatly injured. Since that date there have also been freezes which much injured peach trees. Yellows, however, did not appear until about 1883 and has never been very prevalent. In other parts of the State, *e. g.*, in Washtenaw County and Ionia County, peach trees have suffered repeatedly from cold winters, being killed back more often than not upon low grounds, yet I have never seen a single case of yellows resulting therefrom. At Spring Lake, near Grand Haven, a succession of severe winters between 1870 and 1880 greatly injured peach trees and practically put a stop to the planting of orchards, but yellows did not become prevalent in consequence, and has never proved a serious evil. Nevertheless, in Berrien County, near the same great body of water and 70 miles farther south, the orchards were entirely destroyed by yellows during the same period. Here are two localities subject to the same rigors of climate. When the supposed cause has been acting in both localities why has the disease prevailed only in one?

(4) Sussex County, Del., is almost or entirely free from yellows, unless it be that portion in the immediate vicinity of Milford, yet it was as much subject to the severe winter of 1880-'81 as Kent County.

Seaford is only about 35 miles south of Dover, and the difference in elevation is so trifling that they may be said to be subject to the same temperature, especially during cold waves. Dover has suffered severely from peach yellows for three years while Seaford has been entirely free. In August, 1888, I visited Seaford, talked with many growers, and examined about thirty orchards, some of them very carefully. I did not see a single premature peach or any well-defined case of yellows, and did not hear of any. Most of the growers are entirely ignorant of the symptoms and effects of this disease, so far as personal experience goes. The only suspicious trees I saw were a few in thrifty young orchards recently imported from New Jersey.

About Seaford are many old orchards which were seriously injured by the hard winter and which still show its effects in discolored or dozy heart-wood and partially dead limbs and trunk.

One of the orchards of William E. Cannon was of special interest, because it was very badly injured by the winter in question. The orchard was then three years old. Some of the trees died, and none of them have entirely recovered. The trees lost large patches of bark from trunk and limbs, and the year's wood was frozen brown, and has since become dry or rotten, frequently involving all the annual rings except those laid down within a year or two. There is much dead wood, and a slight pull breaks down large growing limbs. Nevertheless, the foliage was green and full grown, and the orchard bore peaches and looked as if it might continue to bear for a number of years. This orchard now contains five or six hundred trees; originally, seven hundred. I carefully examined each one, but found not a trace of yellows.

An orchard twenty-four years old, belonging to Charles Wright, was also badly injured by the winter and has never entirely recovered. It contained, originally, about eight hundred trees, seventy-five of which are now missing. There are many partially decayed branches and some dead trees, and all are lichen-covered. The orchard bore peaches, and will, no doubt, continue to bear for a number of years. I carefully examined every tree, but found not a trace of yellows. On the same farm is an orchard of one thousand seven hundred trees now fifteen years old. This was also badly injured by the winter, and looks more ragged and broken than the older one, but yellows has never appeared in it. Col. E. L. Martin also has two orchards, one eighteen years old and the other fifteen, which were badly injured by the winter of 1880-'81. Yellows has never appeared in either, and the younger one has borne four good crops of fruit since 1880. I saw both.

The history of these orchards is the history of all the old orchards about Seaford—all suffered from the unusual winter, but none developed yellows.

EXCESSIVE RAIN-FALL.—As long ago as 1807, Judge Peters observed that yellows was unusually prevalent during two successive rainy seasons, and concluded that excessive moisture had something to do with the disease. Since his time many have held the same view, although not much evidence appears to have been brought forward to sustain it. Mr. Rutter, however, states that yellows was very prevalent in West Chester during the rainy season of 1878. Whether the former great outbreaks in Upper Delaware, in New Jersey, Connecticut, New York, Ontario, and Michigan occurred during rainy seasons is uncertain. I have found no trustworthy evidence of such coincidence. On the contrary, Charles W. Garfield states that yellows was much worse at Saint Joseph, Mich., in two excessively dry seasons, 1871 and 1872.¹

Careful rain-fall records in inches are not kept on the Chesapeake and Delaware Peninsula, so far as I know; but from general entries in several weather records and from newspaper paragraphs and the statements of many trustworthy persons, it is beyond question that in the

¹*Ann. Rep. of the Sec'y of the Mich. State Pom. Society, 1872, p. 278.*

vicinity of Dover and Still Pond, and in fact over all the upper part of the Peninsula, there was excessive rain-fall both in 1886 and 1887. As regards 1887, my own observations confirm these statements. It was very rainy—hay was a large crop; corn-fields could not be properly cultivated; wheat spoiled in the shock; weeds grew amazingly; and the peach tree itself made a much larger growth than in 1888. According to Dr. Henry Ridgley's daily record the exceedingly rainy months of 1886 were May, June, and July; and the months in 1887 in which most rain fell were April, June, July, and August. In 1887 the last one-half of April, the whole of July, and the first two-thirds of August were especially wet, the July rain-fall being enormous. In a general way the rain charts of the Signal Service confirm these statements, and would undoubtedly be shaded still more deeply in this region were they based on a larger number of observations. Coincident with these two rainy seasons was a marked increase of peach yellows, which seemed attributable thereto and was so attributed, very commonly.

One could not help noting such a striking coincidence or avoid being influenced by it. Until this year, therefore, I held the view that excessive rain-fall, while not the cause of the yellows, was a necessary factor in its rapid dissemination. It seemed wise, however, to follow the progress of the disease another year before making very positive assertions. It was, therefore, with unusual interest that I waited the season of 1888, hoping it might be dry. Fortunately, it was dry; but a careful study of the disease in five counties¹ showed no marked diminution in the number of newly infected trees. If some orchards showed fewer new cases than in 1887, others in the vicinity showed more, and still others developed the disease for the first time, often in many trees (see record of examinations in numbered orchards). Many other orchards might be cited. I also found that all trees diseased in 1887 continued to be diseased in 1888, and that the disease had invaded contiguous territory which was free in 1887.

It can not, therefore, be said that the excessive rain-fall of 1886 and 1887 was especially favorable to the spread of the disease, unless, as is quite likely, the conditions then produced remained and continued their injurious activity in the dry year of 1888. It may, however, be stated *without qualification* that, contrary to expectation, a dry year following the two wet ones did not check the spread of the disease. Rainy weather may have some influence in *originating* a widespread epiphytic, which is then capable of holding its own during succeeding dry weather. On the other hand, too much influence may have been ascribed to wet seasons from the fact that diseased trees put out a more abundant growth of secondary shoots in such years, and are therefore more easily detected by ordinary observers, or rather not so easily overlooked. In this particular I noticed on the Delaware and Chesapeake Peninsula a very marked difference between 1887 and 1888. In

¹ Cecil, Kent, and Queen Anne in Maryland, and New Castle and Kent in Delaware.

1888 the diseased trees sent out a scanty growth of the abnormal shoots; in 1887 such growths were very abundant.

All things considered, the question of the effect of excessive rain-fall must be left an open one. Certainly it can not of itself cause yellows, because districts only a few miles south of the infected areas suffered from veritable floods of rain and yet entirely escaped the disease. Another season may throw more light upon the subject. It certainly will if it is dry.

EARTH CONDITIONS.

EXHAUSTION OR INFERTILITY OF SOIL.—The belief that peach yellows is in some way related to poverty of soil is not a new theory. As long ago as 1839 a correspondent of *The Farmer's Cabinet* stated that in earlier volumes of that journal he had found no less than eighteen papers recommending "alkaline substances for the prevention or cure of the premature decay of pear and peach trees."¹ Two years later Littleton Physic, of Ararat Farm, Cecil County, Md., highly recommended nitrate of potash for peach trees, his experiments having begun as early as 1836.²

In 1848, J. W. Bissell, of Rochester, N. Y., stated that there is a loss of lime and potash in soils where many peach trees have been grown, and suggested that yellows might be due "to the absence or small quantity of these alkalies." He had never seen any analyses of the wood, but suggested that such be made. The next year Professor Emmons, of Albany, N. Y., published analyses of healthy and diseased tissues (see Appendix A). At this time New Jersey peach-growers were also attributing yellows to bad treatment and poverty of soil.³ They then held, as some of them still hold, that the exhaustion of the land by excessive and unintermittent cropping is a sufficient explanation of the disease.

An analysis of healthy branches was also published in 1854 by Mr. Kirtland.

In 1871, Dr. R. C. Kedzie, of Lansing, Mich., visited Benton Harbor, examined many diseased orchards, and made analyses of healthy and diseased tissues (see Appendix A). He found in the diseased tree a deficiency of carbonate of potash and phosphate of lime, but in view of the fact that the composition of the ash of the same plant varies much according to the age of the plant, the kind of soil on which it grows, and the degree of vigor of its development, he declares that "perhaps it might with justice be said that the results of chemical analysis, like those of microscopic examination [Dr. W. J. Beal's], are merely negative."⁴ At about that date Thomas Meehan, of Germantown, Pa., stated that Dr. Wood, of the Philosophical Society, had found that potash benefited peach trees attacked by yellows.⁵

¹ *Genesee Farmer*, August 31, 1839.

² *The Cultivator*, Albany, N. Y., 1841, p. 128.

³ *The American Farmer*, Baltimore, Md., 1848, p. 87.

⁴ *Ann. Rep. of the Sec'y of the Mich. State Pom. Soc.*, 1871, p. 476.

⁵ *The Gardeners' Monthly*, 1872, p. 17.

In 1882, Charles Black, a well-known nurseryman of Hightstown, N. J., declared that crowding was one of the causes of yellows, and made the following remarkable statement: "If your trees are too thick, pull out every other row, and as a rule you will cure the yellows." Trees are sometimes set as close as 8 or 10 feet, but should be 18 or 20 feet apart.¹

The same year Dr. Goessman, of Amherst, Mass., published his four analyses (see Appendix A) in connection with a paper by Prof. D. P. Penhallow on the microscopic characteristics of the disease.² Dr. Goessman found in the diseased fruit an excess of lime and phosphoric acid and a deficiency of magnesia and potash; and in the diseased branches an excess of iron, lime, and magnesia, and a deficiency of potash and phosphoric acid. Both gentlemen took the ground that the yellows was due to a lack of necessary food elements in the soil, and cited the four analyses in proof. A remedial treatment based on this theory, and consisting of liberal doses of phosphates and of sulphate and muriate of potash, was begun at Amherst, by Professor Maynard, in 1878, and the results of this treatment were also offered in proof.

This treatment was repeated by Professor Penhallow, at Houghton Farm, New York, the results there obtained being embodied in a special report of that experiment station, which was published in 1883.³

In 1884, at the request of P. M. Augur, State pomologist, the Connecticut Experiment Station also made analyses of diseased and healthy peach twigs (see Appendix A), from which it appears that the ash of the diseased tissue contained *no excess of lime*, but an excess of silica and other insoluble matters, and a deficiency of nearly all the other constituents.

So far as I know these are all the analyses yet published, but some interesting additional ones, made at my request, will be found in Appendix A.

In recent years Professor Penhallow is the one who has insisted most strenuously on the correctness of this soil-exhaustion theory, and among practical peach-growers who have given more or less sanction to his views may be named H. H. Appleton, Odessa, Del.; John P. R. Polk, Wilmington, Del.; Eli Minch, Shiloh, N. J.; and J. H. Hale, South Glastonbury, Conn. His treatment, as given in a Houghton Farm Bulletin, Series III, Nos. 1 and 2, and in a more recent communication to the author,⁴ consists in the application of 625 pounds per acre of a mixture, by weight, of 1 part of kieserite (crude epsom salts), 6 parts of muriate of potash, and 18 parts of dissolved bone-black (bone-black in sulphuric acid). This to be applied, one-half spring and fall, just before and after leafing; and, if marked evidence of the disease is present, an additional 2 pounds of muriate of potash must be given to each

¹ *Yellows and Peach Culture, The Gardeners' Monthly*, Phila., Pa., 1882, pp. 111, 112.

² *Trans. of the Mass. Hort. Soc.*, 1882, Part I.

³ *Experiment Orchard and Peach Yellows, Series III, No. 3*.

⁴ Letter of September 19, 1887.

tree in spring and fall. The orchard must also first be pruned severely, to cut out all the noticeably diseased wood.

If peach yellows can be cured in this simple manner every peach-grower ought to know it, for hundreds of orchards in New Jersey, Delaware, and Maryland are being ruined, entailing great financial loss. Even if this treatment can be depended on as a reasonably certain preventive, it is one of the most important horticultural discoveries of modern times. The fact that the ingredients here supplied in a concentrated soluble form are found naturally in considerable quantity in the ash of healthy peach trees is certainly an argument in their favor. If yellows, therefore, is only synonymous with starvation, the results of this treatment ought to be speedy and unmistakable. Six years have passed since the publication of Dr. Goessman's analyses, and many faithful trials have been made by peach growers. What have been the results?

When I began my field-work, in July, 1887, I had no favorite theory to advance, but gave very careful attention to this one, among others, hoping, for the sake of the fruit-growers, to be able to confirm it. This I have not been able to do.

In the first place, there appears to be an error of logic in deriving conclusions from premises. In the diseased tissues Dr. Goessman found a deficiency of potash, and with this fact for one premise, and for the other the knowledge that potash is procured by the plant only from the earth, he and Professor Penhallow assumed a lack of this substance in the soil. Even assuming a constant deficiency of this sort in diseased trees, the conclusion which they reached by no means logically follows; any more than it follows that the leanness of a consumptive or a dyspeptic is attributable to a want of appetite or of sufficient food. If in diseased tissues there is a constant deficiency of potash, such as the analyses seem to indicate, why may it not be an effect of the disease rather than the cause? The amount of this substance is believed to be proportionate to the vigor of growth. In weak and feeble growths, such as are characteristic of the later stages of yellows, we might consequently expect to find less of this element. In my judgment the amount of assimilable material in the soil has little or nothing to do with the deficiencies said to exist in diseased tissues.

Again, it would seem that four analyses, however carefully made, are an insufficient basis for so important an assumption. On this ground alone the fact of any characteristic disparity of chemical composition might very properly be denied, or held in question, until established by many careful analyses. Up to this date only a few have been made, and these are not altogether consistent (see Appendix A). At least half a hundred analyses ought to be made, under various conditions of growth, if anything like exact information is desired. At present we do not even know that trees stunted by borers, by root aphides, or by starvation would not yield chemical results identical with those given by trees suffering from yellows. The probabilities are that they would.

Moreover, knowing from personal experience how easy it is to make mistakes, I am inclined, with all due respect to those who advocate this theory, to think there may also be a possible error of fact as to the alleged cures.

The Amherst trees were set, in 1870, only 12 feet apart; were neglected for five years, and did not receive treatment for yellows until 1878. Only the trees least affected were treated. These became green, bore fruit, and were pronounced cured at the end of three years. We are not told who identified the disease, or whether the trees in question (the identical ones treated) bore the premature red-spotted peaches and the characteristic shoots. Is it not possible that these trees may not have had genuine peach yellows, such as has destroyed the orchards in Michigan and Delaware? I have frequently seen yellow, starved-looking trees which were not suffering from yellows, and these, too, in orchards where the real disease was present. It is easy to mistake something else for yellows if one has had but little experience with the disease. The statements that these trees were on an impoverished hill; that they were set only 12 feet apart; that they were eight years old when the disease was discovered, and that the trees in the richer bottom remained healthy, all lead me to think that some or all of them may have been simply starved trees, in which case they would naturally respond quickly to suitable food. On any other assumption I am at a loss to harmonize my own observations with the statements of Dr. Goessmann and Professor Penhallow, unless, indeed, there should exist a difference in judgment as to what constitutes a cure. My own criterion is that the restored tree must again bear healthy fruit, ripening at the normal time. Any substance which accomplishes less than this is not a remedy, but at best only a palliative.

Professor Penhallow's field work at Houghton farm in 1883 would also appear to offer insufficient data for judgment as to the real merits of the muriate of potash. One tree only was cured of yellows. This had never borne fruit, but was one of a few young trees procured that year from Rochester, N. Y. Is there not a possibility that this tree was suffering from a cause or causes other than that which produces yellows, although manifesting symptoms somewhat resembling it? This cure was effected in 1883. I am unable to say what has been the subsequent history of this tree. It would be interesting to know if it continues healthy and is productive.

Has this remedy given any more definite and satisfactory results in the hands of practical peach-growers? After two years of observation and inquiry in Michigan, Maryland, and Delaware, I must say I can not find that it has. So far as my own observation goes the most that can be said in favor of any phosphate or potash treatment is that the trees become greener and in some cases produce premature fruit for a year or two longer than otherwise. On the Delaware and Chesapeake Peninsula it is the rule rather than the exception to use

commercial fertilizers, and some of the orchards which I have examined have received very large doses of fertilizers containing potash, phosphoric acid, sulphuric acid, chlorine, etc.; but it is almost the universal testimony that as a remedy for peach yellows, or even as a preventive, they are of no value whatever. A few men hold a contrary opinion, and in some instances I took special pains to visit their orchards, learn the treatment and note the condition of the trees.

In September, 1887, learning by newspaper reports of some trees near Smyrna, Del., which had been cured of yellows, I visited the place and examined the trees. They are on the farm of J. Scout, near the village. Mr. Scout himself did not assert that the trees had been cured, but said "There they are. You can judge for yourself."

I found a row of fifteen trees, ten years old, of several varieties. They were on level ground, next a gooseberry patch, and near a prolific vineyard. The treatment began four years previous and was at first accidental. At that time the ground under the trees on the side next the berry patch received the same dressing as the latter--*i. e.*, a very heavy coating of privy manure. Since then in the spring of each year the trees have received a dressing of ground bone at the rate of 600 pounds per acre, and of kainit at the rate of 400 pounds per acre.

The condition of these fifteen trees, numbered from south to north, was as follows:

1. Doubtful.	9. Healthy.
2. Badly diseased by yellows.	10. Badly diseased by yellows.
3. Healthy.	11. Healthy.
4. Badly diseased by yellows.	12. Dead,— by yellows(?)
5. Diseased by yellows.	13. Diseased by yellows.
6. Badly diseased by yellows.	14. Diseased by yellows.
7. Diseased by yellows.	15. Badly diseased by yellows.
8. Badly diseased by yellows.	

In other words, *three* of these trees were healthy; *one* was dead; *one* was doubtful, and *ten* had yellows, six of them being full of the characteristic shoots and badly diseased, while the other four showed unmistakable signs of it. In thirteen and fourteen there were some indications of recovery, but nothing definite. Mr. Scout thinks that all had the disease four years ago, but of this I do not feel certain.

H. H. Appleton, of Odessa, Del., has boned and potashed his orchards very liberally for years, but trees upon his place were badly diseased by yellows in 1887 and 1888, and although his shrewd neighbors are losing their young orchards by the wholesale, as I know from personal inspection, they have not confidence enough in his treatment to apply it to their own trees.

One of the most striking failures of this treatment is on the "Cassiday" or "Peach-Blossom" farm, on the north bank of the Sassafras River, in Cecil County, Md. The farm is now managed by John P. R. Polk, of Wilmington, Del. He has been a firm believer in the efficacy of this treatment, and for four years, *i. e.*, since the disease began to be-

come serious in that region, has given the young 50-acre orchard very heavy dressings of an excellent peach-tree fertilizer, prepared for him by I. P. Thomas & Son, of Philadelphia, after the Penhallow formula, at a cost of \$33 per ton.

I visited and examined this orchard August 29, 1888. It contains 50 acres; the front 15 is six years old; the back 35 is eight years old. The whole farm has been in peach orchard, but in this field ten years intervened between the removal of the old orchard and the planting of this one. The soil is nearly level upland—mellow clay loam with a yellow clay subsoil. The trees are set 108 to an acre. Yellows first appeared in the older part about 1884. The history of the treatment of this orchard and of the progress of the disease, by years, as given by Joseph A. Rickards, the tenant, is as follows:

1884. Kainit was sowed broadcast in the spring on the entire 50 acres at the rate of 300 to 400 pounds per acre [about 50 pounds of potash per acre].

1885. This year there were many premature trees, nearly one-third of the back 35 acres, *i. e.*, the older trees. That fall from 5 to 25 pounds of I. P. Thomas's Peach Tree Fertilizer was put around each diseased tree [about one-half pound to two pounds of potash and the same amount of phosphoric acid per tree]. In all, 4 or 5 tons were thus used.

1886. There were more premature trees this year. The orchard got worse rather than better, and Mr. Rickards wished to dig out all diseased trees, but Mr. Polk objected and desired to continue the treatment. That fall from 300 to 400 pounds per acre of ordinary phosphate, part of it made by Mr. Thomas, was sowed broadcast on the entire 50 acres [6 to 8 pounds of potash and 20 to 30 pounds of phosphoric acid per acre].

1887. The younger, front part of the orchard showed many diseased trees. Nothing was put on the back 35 acres, but on the 15 acres of younger trees the Thomas mixture was applied at the rate of 300 to 400 pounds per acre. This was put on in March or April and plowed under later. The orchard showed no improvement.

1888. No treatment, save the ordinary careful cultivation which has been given each year.

I drove the entire length of the orchard and along one end, and walked through the middle. It is very badly diseased in all parts, and many of the trees are entirely worthless. The boss of the picking gang, who has been on the place five years, and was then at work in the orchard, told me that 20 acres of the 35 was "good for nothing," and would be cut down as soon as time could be found to do it, Mr. Polk having given orders to that effect; in fact 5 acres had already been cut down (see Photo. XXIV made in November). He estimated that about two thirds of the eight-year-old trees were diseased, and I saw nothing which led me to doubt his statement. Of the six-year-old trees, he thought about one-fourth were premature. Following Mr. Polk's direction the tenant began to cut these down, but found so many of them, that he preferred not to execute the order until he should again see the manager and inform him more fully of the exact condition of the trees. The diseased trees were very yellow and sickly looking, some were barren, and others bore premature fruit and the characteristic shoots. The healthy trees, espe-

cially in the younger part of the orchard, bore considerable fruit; they were large, and the foliage was green and vigorous. Evidently they have had good care and plenty of suitable food.

So far as I could judge, assuming for a basis the recent progress of the disease in all that part of Maryland, the fertilizers have had no effect whatever in retarding its spread. It has gone on increasing from year to year until now the orchard is very badly diseased. It is certainly as bad as any untreated orchard within a radius of 10 miles, and much worse than several orchards on the south side of the Sassafras River, on similar soil, and on land which has been "peached" once and has received no special treatment. In my judgment it would have been better to have removed the diseased trees, from year to year, as fast as they appeared. If I have not been misinformed, Mr. Polk is now also of this opinion.

Orchard No. 1 of this report received 200 pounds of ground bone and 200 pounds of muriate of potash per acre when three years old.

Orchard No. 2 has also received a good deal in the way of phosphates, potash salts, and barn-yard manure for a series of years.

Orchard No. 14 received kainit broadcast in the spring of 1885, at the rate of 400 pounds per acre. Phosphates and barn-yard manure were used on the field for other crops previous to setting the trees, but not since. The level 30-acre field lying south of this orchard produced between 29 and 30 bushels of wheat per acre in 1888. I saw it fallowed in 1887, and the soil appeared to be identical with that of the orchard.

Orchard No. 16 has been remarkably productive, but has received very little in the way of fertilizers. It is thirty-three years old, and never suffered much from yellows until recently. This orchard may be compared with No. 2, which is on much the same kind of soil; or with No. 18, which was not old enough to bear until 1888, and then produced only a sprinkling of peaches, mostly premature; or with No. 3, which made a vigorous growth, and bore only one or two light crops before succumbing.

Again, on the supposition that yellows is due to exhaustion of soil, ought it not to appear in old rather than young trees, in trees which have produced excessive crops of fruit for many years in succession rather than in those which have borne only one or two light crops or even none at all? The reverse of this is true. I have found yellows more rapidly destructive in young than in old orchards. I know a number of instances where very productive old orchards have been entirely spared for the first fifteen or twenty years, while young orchards on the same farm, or in the immediate vicinity, have become very badly diseased during the first six years of their orchard life. In some cases where soil, location, method of cultivation, etc., appeared to be the same, I have found that old and young trees were attacked at about the same time, both being injured alike, or the young suffering worse; in other cases the young orchards have been attacked a year or two sooner

than the old ones. The reverse of this, *i. e.*, old orchards attacked first, is sometimes true, but on this theory it ought to be true always, or at least very commonly. This is certainly far from being the case. Of the eighteen orchards specially mentioned in this report only four are over nine years old, and a number of them have been set only three, four, and five years.

A general consideration of the way in which the disease spreads appears also to be opposed to the view that it results from soil exhaustion. Within five or six years it has appeared in nearly all the orchards on the upper part of the Delaware and Chesapeake peninsula, and for the last two or three years it has affected tree after tree very rapidly. In that region it is now on all kinds of soil, clay, clay-loam, sandy-loam, and light sand; on the richest farms and on the poorest; on new and old lands; on impoverished hill-tops or hill-sides, and in rich bottoms; in young and old trees; in budded fruit and in seedlings; in transplanted trees and in those which have never been moved; in trees crowded, set 20 feet apart, and even 40 feet apart; on moist fields and dry ones; on highly-fertilized soils and on those which have received a minimum of fertilizers or none whatever. These statements, every one of which I have verified repeatedly in Maryland and Delaware, have also all proved true in the experience of Michigan peach growers, as I know from correspondence and conversation with many of them. Is it probable, or even within the bounds of possibility, that *suddenly* all the orchard lands in whole counties should become exhausted and incapable of growing the peach; capable still, however, of growing excellent corn and wheat, and fine vineyards and pear and apple orchards? The chemical analyses of the peach reveal no peculiarity of composition that would warrant any such belief.

Moreover, in some of the lower counties of the Chesapeake and Delaware peninsula, which have been settled as long and have grown peaches nearly or quite as long, yellows has not appeared, at least not so as to be noticed, although the soil is lighter and less fertile.

Sussex County, Del., in particular, contains large tracts of very sandy land, and is noticeably less fertile than Kent County. Indeed, from Seaford to Delmar, along the line of the railroad, it is almost a barren waste of sandy, scrub-pine country. Corn and wheat will not grow. Melons and small fruits are the principal products, blackberries being the crop which thrives best. Peach trees planted on this land are yellowish, small, and starved, and the orchards seldom live more than ten or twelve years; yet, in the whole region I did not see or hear of a case of yellows. The trees sometimes starve, but do not die of yellows. In many orchards it is also the practice, and has been for years, to double-crop the land by planting four or five rows of strawberries or of blackberry bushes between the orchard trees. These strong-feeding plants take from the soil much potash, phosphoric acid, and other mineral matters, and the peach trees evidently feel the loss; but not even in any of these

orchards could I find yellows, although I tramped patiently over many acres and examined hundreds of trees.

In driving from Seaford to Laurel I passed through an especially dreary country. I have seen nothing like it except in the pine barrens of Michigan. The timber was chiefly second growth scrub-pine (*Pinus inops*, Ait.) or old-field pine (*P. Taeda*, L.). *Cassia chamaecrista*, L., *Comptonia asplenifolia*, Ait., and similar plants of barren land were common. The roads were of deep, loose, yellow sand. The wheels settled in over the felloe, and it was not possible to drive faster than a walk. All along the road—in soil, crops, orchards, houses, fences, and inhabitants—there was every indication of poverty, and sometimes of a hand-to-mouth fight with starvation; yet no indication of yellows. Now, in the name of all the chemists, if yellows and starvation are synonymous, why does the disease prevail on the rich loams of Kent and New Castle and not in Sussex?

The better soil north of Seaford is a flat, shallow, gray sand, capable of growing 10 or 15 bushels of wheat per acre, but not nearly as fertile as the clays and clay loams of Kent County. There I saw no yellows, and could not learn that it had ever been in that vicinity, the only suspicious trees being recent imports.

In Maryland a similar parallel might be drawn between the sandy pine lands of Caroline County and the loams and clays of Kent County. Kent is much the richer county, but, so far, Caroline has almost entirely escaped the yellows, while Kent has suffered very severely. The more southern counties of Maryland, such as Dorchester, Somerset, and Wicomico, also contain much poor, sandy land, but yellows has not been reported from that part of the State.

Again, my observation has been that thrifty trees on fertile soil are quite as likely to be attacked as any. In orchards Nos. 2, 10, 14, 15, and 17 of this report the largest, most rapidly growing trees, on the richest parts of the field, *i. e.*, those receiving the drainage, were the first to be attacked. In Nos. 3, 6, 10, and 14 *all the trees* had made a remarkably fine growth. Orchards Nos. 1, 5, 6, 7, 8, 10, and 14 are on good clay-loam soil, capable of growing from 20 to 30 bushels of wheat per acre and 40 to 50 bushels of shelled corn. Many other affected orchards which I have examined are on excellent soil, judging from its appearance, from the growth made by the trees previous to becoming diseased, and from the character of the wheat, corn, and other farm crops growing in the immediate vicinity. The same fact has been observed by others repeatedly in Delaware, Maryland, and Michigan. A. S. Dyckman, one of the largest growers at South Haven, Mich., told me that he had a sandy bluff the soil of which had been blown away to the depth of 1 to 2 feet by the winds of Lake Michigan, so that nothing but the sandy subsoil remained. Peach trees were set in this sand, and made almost no growth for a number of years, but grew and bore peaches when manured. In a rich bottom in the same orchard trees

suffered from yellows, but none were attacked on the bluff, although the soil was too poor to grow peach trees, or even grass or weeds, until it was heavily manured.

There is a general impression that peach yellows is more destructive in orchards planted on land previously occupied by peach trees. This has been ascribed to impoverishment of soil. The belief, no doubt, arose from the common observation that in districts long infected and where, so to speak, the disease has become endemic, second plantings decay speedily. In such places I am inclined to think this speedy decay is in some way connected with *locality*, but do not believe it to be the direct result of impoverished soil. At Odessa, Del., I had good opportunity to observe this. That region was formerly very thickly planted with large peach orchards, which disappeared in the seventies, largely on account of the prevalence of yellows. The more enterprising farmers set new orchards, and in 1888 I had an opportunity to examine them. They are from one to eight years old, and almost without exception those which have been planted over three years are badly diseased; but the orchards set on the site of former orchards do not seem to be worse affected than those set on ground never before in peaches. One of the worst orchards seen is near the Delaware River, on the farm of E. C. Fennimore. The trees are six and eight years old, set on sandy land, clay subsoil, previously occupied for sixteen years by the very productive orchard already mentioned. The old orchard suffered badly from yellows toward the end, and was entirely removed in 1874—seven years before the field was again planted to trees. At the time of my visit Mr. Fennimore was pulling out orchard trees with a span of mules, and I saw large strips from which the trees had been removed in 1886 and 1887. Many of the trees were badly diseased, and a natural inference was that the previous orchard had exhausted the soil. However, the orchard is not more badly diseased by yellows than Nos. 1, 3, 7, 8, 11, and 17 of this report, which are on land never before in peaches; nor is it worse than others which I have seen in Maryland and Delaware on "unpeached" land.

Somewhat farther south in Delaware, where the disease is now obtaining a strong foothold, it does not attack orchards on "peached" land any sooner or any more destructively than those on land never before in peaches. I have observed the same fact in Maryland in a number of instances. Some cases may be cited:

About four-fifths of orchard No. 9 of this report is on land previously occupied by a peach orchard, but this portion has not suffered worse than the rest of the orchard (see Table VII). A portion of orchard No. 10 was formerly in peaches, the trees being removed nine years before the present orchard was set. Nevertheless, this part of the orchard was not attacked any sooner, and has not suffered more severely than other parts (see Map III). Two orchards near Still Pond, Md.,

on "peached" land have suffered much less than Nos. 1 and 2 of this report, although they are not far from the latter.

Diseased trees also occur in fence-rows and by roadsides at a distance from the orchards, near ash-heaps and piles of stable refuse, the drainage of which they have received, and in gardens, lawns, and city lots. In short, in the badly-infected areas I have found the disease wherever I have found peach trees. In the uninfected areas I have found the disease in none of these situations. Between badly infected districts and uninfected ones there is also a middle ground in which may be found some affected trees or orchards.

These facts are all opposed to the Goessman Penhallow theory. There is, however, a still more serious objection.

If yellows is due to soil exhaustion, the most convincing proof should be found in localities where the action of other presumptive causes, *e. g.*, contagium, freezing, etc., have been reduced naturally or artificially to a minimum. Manifestly it will not do to accept affirmative evidence on this point from sections of the country where several supposed causes are acting unrestrainedly at the same time, and any one of which may be the true cause. For this reason the whole Atlantic coast may be ruled out, and also a large part of the Northwest. In all this region either the winters are severe, or the disease is not present, or it is allowed to spread without any general, systematic effort to check it. The only localities really suitable for such an inquiry are (1) those parts of the South where the climate is mild and the disease has never appeared, and (2) the peach belt of western Michigan, close to the lake shore, in the vicinity of South Haven, Van Buren County, and in the townships of Casco, Ganges, and Saugatuck, Allegan County, where the yellows law is enforced and where the lake tempers the severity of the winters.

The soil in many parts of the South was "exhausted" years ago, and yet peach trees continue to be comparatively free from yellows, and often live twenty or thirty years. However, as I am more intimately acquainted with conditions in Michigan, I will confine the discussion to that region.

The four Michigan townships named border Lake Michigan for a distance of 24 miles, and comprise the most important peach district in the State, the only one at all comparable with the peach regions of New Jersey, Maryland, or Delaware. The country has not been well settled more than thirty or forty years and there is still considerable virgin forest of pine, hemlock, beech, and maple. The character of the soil varies from a light sand to heavy clay loam. At South Haven, and generally near the lake, it is sandy. Some miles inland, at least in Allegan County, the soil is heavier and more fertile.

In accordance with State law, supported in this region by a very strong public sentiment based on a nearly universal belief in the communicable nature of yellows, diseased peach trees are cut down or dug out and burned as soon as discovered. In this way, on the theory of spread by

contagium the infective material, whatever it may be, must presumably be kept at a minimum. If it is developed in the tree it can never be very abundant, for there are never very many diseased trees in existence at any one time. The proximity of Lake Michigan also tends to prevent injuries by freezing.

Here, then, the influence of two supposed causes is reduced to a minimum, and the effect of soil exhaustion will, if anywhere, be freed from complications, and in condition to be estimated more nearly at its true value.

The fact that cases of yellows still appear in this region, year after year, in spite of the modifying influence of the great lake, and in spite of the comparatively strict enforcement of the law, would, at first, seem to favor the theory of soil exhaustion, but really does not. Some very stubborn facts stand in the way of the acceptance of this theory. These are :

(1) Yellows is much less prevalent where the law has been strictly enforced. This phase of the question will be considered later at some length under "Influence of legislation," and need only be mentioned here. Of the fact itself I think there can be no doubt.

(2) Yellows has appeared in this region on productive virgin soil, *i.e.*, on land cleared of the original forest within less than a decade, and never exhausted by cropping. This statement is so important that I have been at great pains to verify it, by extensive correspondence, and later by a visit to the region. There seems to be no doubt whatever about it.

(3) Healthy trees can be grown without lapse of time and without fertilizers in the places previously occupied by diseased ones. In this region it is the custom, and has been for ten years or more, to set peach trees in the place of those dug out on account of yellows, and these resets *are not more liable to the disease than other trees in the orchard.* In fact, from many reliable peach-growers in southwestern Michigan I have received straightforward independent testimony showing that trees set in place of those unmistakably diseased by yellows have come to maturity and borne healthy fruit, and are now healthy. Such a state of affairs could not possibly exist, not generally, if soil exhaustion were the cause of yellows or one of the necessary factors in its production.

Granted this fact alone and it would seem that the theory of poverty of soil must necessarily fall to the ground, for if one tree has exhausted the soil so as to become diseased how can another tree be set immediately in the same place and come to a healthy maturity? So important is this matter that I desire to introduce abstracts from some of the more important statements received.

On March 24, 1888, and again April 9 and 16, I sent the following question, or modified forms of it, to peach-growers in southwestern Michigan :

QUESTION.

In your experience have you ever succeeded in growing healthy peaches from trees set in the place of those dug out on account of *unmistakable yellows*; *i. e.*, set in place of trees which bore the premature red-spotted fruit, or the starved wiry branches, or both? If you have done so, when was it and under what circumstances, and how long did the trees remain healthy?

To these questions I received the following replies:

ANSWERS.

(1.)

SOUTH HAVEN, MICH., March 26, 1888.

I have little personal *experience* bearing upon the question of soil-starvation as a cause of yellows, and I have never planted a tree in place of one diseased; but this has been done to a considerable extent in orchards here, and I have not heard of disease traceable to this cause.—T. T. LYON.

(2.)

SOUTH HAVEN, MICH., April 2, 1888.

I have taken up peach trees that had the yellows, and reset in the same places, and have picked peaches from said trees two years and they are perfectly healthy yet.—D. C. LEISENING.

(3.)

FENNVILLE, MICH., April 11, 1888.

I have done so *successfully*. I planted an orchard on new ground, and out of that orchard one year I cut twenty trees, adjoining, all of which had *unmistakable yellows*—which showed spotted fruit and wiry fungus growth. The trees planted in the places of those taken out have borne nothing but the best of fruit, showing no signs of yellows, and are still bearing.—J. P. WADE.

In response to a letter asking for more explicit information on certain points Mr. Wade replied again, under date of April 16, as follows:

The twenty trees were dug out in 1882, and young trees planted in same places in 1883.

The forest timber was beech and maple. I had one crop only after clearing before the trees were planted.

The trees were five years old when the yellows was first discovered, with the exception of one tree the year previous.

(4.)

SOUTH HAVEN, MICH., April 12, 1888.

Perhaps to answer your question simply by saying "Yes," would not be as satisfactory as to give you some brief examples.

I came into this country in 1852, when it was one vast wilderness. After the first two years, having some improvement, and knowing that our neighbors south, at Saint Joseph, were raising peaches, we thought we would try it, and up to this date have raised peaches; have set five different orchards at various times on my farm, and in the first three never saw any yellows. From 1875 have had a few cases of the yellows, but with ax and spade soon cured them. Then the question arose, "Can we set trees in the place where those with the yellows have been taken out?" The question was discussed very thoroughly in our pomological meetings. By some it was thought to be dangerous, but the experiment was made and found successful; and for the last seven or eight years we have taken out the affected trees and the spring following have set in the same place, and have raised as fine peaches as we ever raised, free from any blight.—S. G. SHEFFER.

(5.)

FENNVILLE, MICH., April 11, 1888.

We have no trouble in making trees grow in the place where we have taken out trees that had the yellows. I have an Early Crawford tree that I set in the place of

one that had the yellows seven years ago, and it has borne fruit for the last four years, and shows no signs of the disease yet. Last season I picked three baskets from it of nice marketable fruit, and it bids fair to have on a good crop the present year.

As far as my experience goes a new tree will grow just as well where you take out a tree that has the yellows as it would if the tree had been in the best of health. You can't set a tree in an orchard of old trees and have it do as well as it would if the trees were all young, as the old trees shade the ground with their wide-spreading tops, keeping off the rain and dew, and with their long roots sap the ground of the nourishment that the young tree needs to make it grow. I think the young tree starves to death.

Two years ago I put in new trees in place of those taken out on account of the yellows. I gave the ground a liberal dressing of leached ashes, and you never saw finer looking trees than these are at the present time—full of fruit-buds and capable of holding from one to two baskets of peaches.—W. H. MCCORMICK.

(6.)

SOUTH HAVEN, MICH., April 1, 1888.

The first case of yellows in our orchard was in 1872, but I think it was discovered in Rossiter Hoppin's orchard, and perhaps in one or two other places, a year or two earlier. My attention was first particularly directed to it in 1872.

I have practiced setting trees in the places where they have been cut out on account of yellows, some of them badly affected. Have trees in such situations now several years' bearing. Several of our neighbors likewise. The main thing is to watch vigilantly, cut out promptly, and without mercy. *Stamp out the disease* and guard against infection.

Some of our *best cultivators* have large bearing trees in place of orchards destroyed by yellows. But they are thorough men. Our *careless men* have gone out of the business.—A. S. DYCKMAN.

(7.)

GANGES, MICH., April 12, 1888.

Last season was the first time the yellows ever appeared on my place. I had a few cases in my old orchard. I am satisfied, however, that as healthy trees may be grown where diseased trees are taken out as could be grown on the same ground in places where healthy trees of the same age had been grown, provided there is no part of the diseased tree left growing.

No one here, so far as I know, hesitates about planting new trees in the places from which diseased trees have been taken, unless it might be for the reason that the ground had become exhausted.

Hon. D. W. Wiley, of Douglas, Mich., planted five trees in the places from which as many diseased trees were taken, twelve or fifteen years ago, and these five trees are still living, and bearing as well as if no diseased trees had ever occupied the ground.

Capt. Robert Reid, of Douglas, Mich., Rev. A. C. Merritt, of South Haven, and hundreds of others have thousands of trees growing and bearing well on land that was once occupied by trees that had the yellows.—A. HAMILTON.

(8.)

GANGES, MICH., April 14, 1888.

I have succeeded in growing healthy peaches on trees set in place of trees removed which showed the first stages of the yellows, namely, the premature ripening and spotted appearance of the fruit.

My first experience with yellows was eight years ago. I had one tree which *unmistakably* had yellows. I cut it down as soon as discovered, which was in August, and late in the fall pulled out the stump, and removed both stump and branches, and the following spring set another tree in the same place, which commenced bearing the third year, and has borne a crop every year since, and still remains healthy. I have had from one to a dozen trees diseased with yellows every year since, and have

continued the practice as stated above, many of the trees bearing now. Have never yet had a tree show yellows where set in the place of one removed.

I always cut down as soon as the first symptoms appear; seldom have one showing the wiry growth. Have never used any preventatives; always give thorough cultivation through the fore part of the season until about the 1st of August.—A. W. FISHER.

(9.)

SOUTH HAVEN, MICH., April 17, 1888.

In answer to your first question I can say, *yes*, most emphatically, with this qualification, not "or starved wiry branches." The trees that I have cut out with yellows have nearly always been *thrifty and vigorous*, showing the disease only in the fruit and sometimes only in two or three peaches, while all the rest would be healthy, and often only one or two limbs would be visibly affected. Thorough cultivation has been my practice, and also to take out a tree as soon as it shows the disease. I have bought and set a few trees that never showed anything *but* the "starved wiry," fungus growth, but took them out and burned them as soon as discovered. Had I carried over yellows trees to bear the second season, doubtless I could say yes to the last clause of your first question.

Question 2. [When was it?] I first discovered unmistakable yellows in the fruit of one limb of one tree in my peach orchard some fifteen years ago. I dug the tree out and burned it before the crop matured. Do not remember as I reset the following spring in this particular case, but did very soon thereafter. Have had yellows ever since, reaching as high as seventy-five bearing trees in a season, and it has been my *practice* to reset the following spring, all these years.

Question 3. [Under what circumstances?] I had read of the disease. The fruit was getting color weeks ahead of the rest of the tree, or others. I believed it to be the yellows, invited my friends to see it, the first of whom unhesitatingly denied its being the yellows, but could only say it was getting prematurely ripe for some reason. He was as inexperienced as myself, and that I was right my subsequent experience proved. A few trees followed the same fate the next year, and for several years I took out and reset from thirty, forty, fifty to seventy-five, and then ran down to fifty, forty, thirty, ten, one, one; and last fall, with four thousand trees set and two thousand bearing, I lost six trees. You will notice that two falls I had but one case each.

Question 4. [How many trees were thus reset?] I cannot give the exact number reset, but I fill every vacancy every spring, and the most of these trees are in bearing, and many of them have been until they are past their prime.

Question 5. [How long did the trees remain healthy?] I am not certain that I have lost a tree with yellows the second time in the same place. Since the orchard reached a large growth, filling vacancies has been, of course, at a great disadvantage to the newly-set trees, but evidently the fact that yellows trees preceded them has nothing to do with it. I apply ashes and a little manure to the soil where the old tree grew for the sustenance of the new; and *for years*, and *last fall*, the tree occupying the ground where I lost my first tree with yellows was heavily laden with healthy peaches, and that is only one among many like it.

Question 6. [What reason have you for thinking that the trees dug out were diseased with yellows?] I need only say that from observation and experience I know the yellows at sight as readily as I do the most familiar varieties of fruit or the difference in different species of trees. The best written description of the yellows is as nothing (in conveying an idea or knowledge of it to a person who has never seen it) in comparison with the certainty of knowledge and ability to detect it (when there are visible signs) that come to some who have a practiced eye by long and interested familiarity with it.—A. C. MERRITT.

(10.)

DOUGLAS, MICH., April 18, 1888.

My own experience and that of some of my neighbors has, I think, fully established the fact, with us, at least, that healthy fruit has been and can be grown upon trees planted in the place where trees diseased with yellows have been removed.

My first experience in this direction occurred the summer of 1874, when, in an orchard of some four thousand trees, I discovered six trees of the Early Crawford variety, all heavily laden with fruit and standing quite near to each other, showing unmistakable signs of yellows. A part of the fruit on each of these trees was spotted with red spots, the red streaks extending from the surface to the pits. I had those trees dug out at once and burned, and the following spring planted trees in the same places. These trees came into bearing the third and fourth year from planting, and produced fine, healthy peaches, and continued in so doing during the life of the trees.

At the present time I have one tree that bore its first fruit last season, being four years old this spring from setting. The fruit was perfectly healthy. This tree was set in the place of one taken out that had the wiry growth of wood, and had yellows, and no mistake.

From my own experience, and with quite extensive observation as commissioner of yellows for four years, I am strongly inclined to the belief that where trees having yellows are promptly removed and destroyed there need be but little cause for alarm but what we shall be able to furnish healthy and fine peaches for many years yet.—D. W. WILEY.

(11.)

DOUGLAS, MICH., April 18, 1888.

In reply to your first question, yes. For three years have been gathering peaches from those reset. Those dug out bore the spotted fruit and had the wiry growth.

2d. [When was it?] In 1878—ten years ago.

3d. [Under what circumstances?] Condemned by the yellows commissioner.

4th. [How many trees were thus reset?] Three hundred.

5th. [How long did these trees remain healthy?] Those reset are healthy to-day.

6th. [What reason have you for thinking that the trees dug out were diseased with yellows?] Because the fruit was spotted, insipid, and some of the trees had wiry growth, and were condemned by the yellows commissioner. The three hundred trees were taken out of an orchard of two thousand trees.

I lost an orchard of five hundred trees, which I reset two years ago, and the trees are doing well.—ROBT. REID.

I made additional inquiries and Mr. Reid replied as follows, under date of April 26:

In answer to your first question [How long after you dug out the three hundred yellows trees before you reset?] The next year, 1879.

2d. [When you reset did you manure these trees or give them any other treatment very different from the rest of the orchard?] Used no manure, but put air-slaked lime on all my orchard. Have manured since. The soil is gravelly—wheat soil.

3d. [In the other orchard of five hundred trees destroyed by yellows, and reset two years ago, how long a time intervened between the digging out and the resetting, i.e., what year did you dig them out and what reset?] Three years. Dug out the last in 1883; reset in 1886.

4th. [Have you used potash or any special fertilizer on the trees reset two years ago in place of the five hundred, so that this might possibly account for their healthy appearance?] Have used air-slaked lime on them also. I followed, as near as I could, the directions found in John Rutter's book on Peach Yellows.

(12.)

DOUGLAS, MICH., March 16, 1888.

I have trees growing, that were planted where trees having the yellows were taken out, that have borne healthy fruit three years and show no signs of disease.

JAMES F. TAYLOR.

Finally, the recent admission by Professor Penhallow that restored trees are liable to a relapse; the statement by Henry Race, of Pittstown, N. J., that trees can be reclaimed only when the disease is in an

"incipient" state; the statement by Charles Black, of Hightstown, N. J., that badly diseased trees can not be cured, and the universal New Jersey practice of removing diseased orchards when they are only six or eight years old, would seem to warrant the belief that the potash and phosphate treatment, which has been most vigorously championed in that State, does not really cure peach yellows, or even prevent it.

In regard to "incipient" yellows, I must acknowledge that I can not detect it with any degree of certainty. Others are probably as helpless. I am sure of my diagnosis only when I find the symptoms previously recorded as characteristic of yellows, and then the disease is no longer "incipient." If we are to discuss this subject intelligently, we must know beyond any question that we have in mind the same malady.

I have given more attention to the Goessman-Penhalloow treatment than to any other because it has been more prominently before the public, and because it seemed to offer more reasonable hope of success than any other. However, there is no end to so-called remedies. If we may believe published statements, peach yellows has been cured by stable manure, urine, house slops, lime, gas lime, wood-ashes, potash, chlorate of potash, saltpeter, ground bone, bone-black, hot lye, hot soap, hot water, fishbrine, fish compost, and various other commercial fertilizers, especially those compounded of muriate of potash and dissolved bone-black, and sold under the name of "Peach Tree Fertilizer," or "Peach Yellows Remedy." Some manufacturers have also advertised such fertilizers as possessing the property of *germicides*. All such statements are false and misleading, and are not made in the interest of peach growers.

WET AND RICH SOILS.—In some orchards which I have examined the disease was unquestionably worse in bottoms and sags, which receive more or less drainage from other parts of the field and are naturally richer and moister, as shown by the appearance of the soil and by the larger growth of weeds and trees (see Map IV, Spots I, III, and IV, where this was particularly noticeable). It is less apparent on Map VII, but this may be owing to the fact that on two sides of that orchard in the near vicinity are older trees badly diseased for some years, and from which this orchard may perhaps have been infected, if it did not bring its infection from the nursery. However, the disease does not always start in the lowest part of an orchard, and is by no means confined to sags and bottoms, as the maps show clearly enough. Even in the same orchard, where it affects bottoms, one may be taken and the other spared. Orchard No. 12 of this report affords a striking illustration of this. It contains two shallow sags of about the same area, and of the same general character, as determined by soil, moisture, weeds, and the growth of trees. If anything, the northwest sag is a little moister and less fertile. The same weeds grow in both, but in 1888 the weeds were observed to be a little ranker in the south sag. The northwest sag is planted with the Beers' Smock. The south sag is planted with trees purchased for Salway, but which

seemed to me identical with Beers' Smock. The northwest sag contained no diseased trees in 1887 and only one appeared in 1888, that one being on the outer edge. In the south sag, in 1887, which was the first year of attack, I found eleven trees badly diseased by yellows, and eleven months later, when the orchard was re-examined, I found ten additional cases in that sag and on the dry ground immediately surrounding it. Most of the Crawfords which became diseased in 1888 were also near this bottom. Had the disease first appeared in the northwest sag, I have no doubt the conditions in 1888 would have been reversed (see the marked tendency toward grouping exhibited on the maps). The general opinion among prominent peach-growers, both on the Chesapeake and Delaware Peninsula and in Michigan, is that the disease is more likely to appear first in bottoms and rich places. This coincides with my observations.

The effect of moist spots, as well as of excessive rains, has been ascribed to the dilution of mineral constituents in the earth fluids, whereby the tree starves in the midst of plenty. Another explanation is that root-fungi and various micro-organisms thrive better in such situations I have at present no theory to offer.

ARTIFICIAL OR CULTURE CONDITIONS.

NEGLECT OF CULTIVATION.—This was once a favorite explanation of the disease, particularly with writers who never went abroad, but evolved truth from their inner consciousness. In recent years, however, I have heard it asserted that trees left in sod and otherwise maltreated were the only ones free from disease. There is no truth in either assertion, or rather each is only a half truth. Many orchards in Maryland and Delaware are kept entirely free from grass and weeds and are cultivated more thoroughly than the corn-fields; but cultivation from early spring to middle summer, or even all the year round, has not been able to prevent the appearance of yellows, or to hold it in check. Many orchards which have received the utmost attention have become badly diseased. On the other hand, neglected orchards are by no means free from the disease. I have seen it in a number of such orchards; *e. g.*, in 1887, at Still Pond, Md., in a small old orchard owned by J. Frank Wilson. This had been in sod and used for a sheep pasture four years, but contained quite a number of recently-diseased trees. Again, in 1888, on the farm of G. M. Eldridge, near Cecilton, Md., I saw many diseased trees in an old orchard used as a pasture. This orchard has been plowed only once in six years, and that was some time ago. The disease also occurs frequently on lawns and grass plots never plowed or otherwise disturbed (Photo. V), and I have moreover seen it in trees on soil entirely free from vegetation and packed hard by the daily tread of many feet.

NEGLECT OF PRUNING.—This was a favorite theory with A. J. Downing. He advised the shortening-in of the bearing wood one half every spring. If the trees came from an originally healthy stock he believed this

would keep them healthy. There is, however, no good reason for believing it would. S. H. Wilson, of Baltimore County, Md., claims to have tried it faithfully with no success.¹ I can not from my own observation furnish any testimony on this point.

EXCESSIVE USE OF NITROGENOUS MANURES.—The belief that the spread of yellows is favored by the use of animal manures is quite prevalent, and appears to have some basis in fact. One of Dr. Henry Ridgely's orchards which blighted most rapidly with yellows was very highly manured. The McDaniel orchard, Map VI, was also twice very heavily manured soon after being set. The Price orchards, Nos. 2 and 3 of this report, have also been freely and repeatedly manured. In particular a narrow strip, of perhaps one-half acre, on the northeast side of No. 2, which contains some stones and was believed to be less fertile, received great quantities of dung, and there I found nearly every tree diseased by yellows.

Orchard No. 1, however, has received no manure, except two loads on the spot indicated on Map I. Moreover, in uninfected localities, I have seen orchards which have been heavily manured, and they were healthy. The general tendency of nitrogenous manures is toward the excessive production of wood and foliage.

Summing up the evidence, I am inclined to think that, in infected districts, nitrogenous manures have a bad influence, but to what this is due I am unable to say.

DEGENERACY DUE TO CONTINUED PROPAGATION BY BUDDING.—A sufficient answer to this is the statement that yellows affects seedling trees no less destructively than budded ones. This I have verified repeatedly. Seedlings are not exempt, and I have not even been able to show that our oldest varieties are any more subject to this disease than those but recently originated. My examinations in over two hundred orchards have led to no positive result. All varieties appear to be subject in like degree when all other conditions are the same. In some orchards, indeed, certain varieties were much worse affected than others; but often the very next orchard would furnish contradictory evidence—*e. g.*, in No. 1 of this report Christiana was most badly diseased, while in No. 4 this variety had suffered very little. In No. 2, Mountain Rose is badly diseased; in Nos. 4 and 5, this variety is scarcely at all affected. In No. 5, Early Rivers suffered much in 1887 and previous years; in No. 12, not at all until 1888.

Even in the same orchard other things than variety control the spread of the disease (see west sag and east bottom, on Map IV). This is quite different from what occurs in many diseases due to fungi, where the limiting effect of variety is very sharply marked. In peach yellows, no matter which variety is first diseased, all become affected alike in the course of a few years (see Maps I and III, and Tables VI and VIII). Neither is it true, as some have asserted, that the variety

¹ *The American Garden*, N. Y., 1887, p. —.

which shows the disease first is always the first to become badly affected. In orchard No. 5 yellows first appeared, in 1885, in one tree in the Mountain Rose variety. This was removed in the fall, and no more affected trees appeared in that variety until 1888--then only three. Other varieties, however, were affected in 1886 and 1887, some quite badly, as may be seen by consulting Table IV.

Knight,¹ Von Thümen,² and some other European writers have insisted that continued propagation by buds, cuttings, etc., leads to degeneracy, and there is a very general impression among farmers and fruit-growers that varieties "run out." This theory is not wholly unreasonable, and yet a vast amount of careful experimenting must be done before it can be said to rest on any broad basis of well-established facts. Propagation by budding secures the continuation of a variety for an indefinite period, but this is the ordinary method of reproduction in some of the lower plants, and is something quite different from *inbreeding*. We know by direct experiment that the latter is injurious, but our knowledge of the effect of continued budding propagation is largely guess-work. It may produce deterioration, but there is no unimpeachable evidence that it does. In the higher animals there is a distinct individuality, but in some of the lower animals and in plants it is difficult to decide what constitutes an individual. Strictly speaking, we can not take an analogy from the animal world and say that budding perpetuates an *individual* indefinitely, and must therefore lead to superannuation. If we are to use this term at all, it would probably be best to restrict it to each new-formed bud, in which case there certainly could be no such thing as superannuation. The other logical extremity is that taken by Prof. Huxley in his discussion of the non-sexual reproduction of aphides, etc. According to this view all the Crawford's Early or Old Mixon trees in existence are parts only of one individual. These opposing views appear to be about equally absurd.

PROPAGATION BY MEANS OF IMPERFECT OR DISEASED PITS.—There is undoubtedly some reason for believing that the disease is propagated by diseased pits. I can not state positively that trees grown from premature peaches will develop yellows, but I think it likely. There can be no doubt that such seeds have an enfeebled vitality, and it is not likely that they will give rise to robust trees. How great the danger may be from this source I am unable to say. Some experiments of my own lead me to think it is overestimated. Exact experiments to determine this point have not been very numerous.

Some years ago G. H. La Fleur, a well-known nurseryman at Mill Grove, Mich., made a number of trials to determine this. In his first experiment he obtained a few sickly-looking seedlings from pits taken from trees having the yellows. The growth was not to exceed 10 inches.

¹ *Trans. of the Hort. Soc. of London*, first series, Vol. V, 1824, p. 384; and second series, Vol. I, 1835, p. 147.

² *Die Bekämpfung der Pilzkrankheiten unserer Culturgewächse*. Wien, 1886, p. 7.

They had the appearance of unhealthy trees, and were pulled and burned. In his next experiment he planted in the fall, without cracking, a peck of pits taken from trees having yellows. None grew. The next season, 1881, he obtained a peck of pits selected with great care from fruit showing yellows plainly. These were placed in sand in the fall, in the same manner as he treated healthy pits. In the spring he cracked them himself, and found only one in a normal condition. All the others had turned black or dark-colored, and were mostly decayed. The one pit which had the appearance of being sound was planted, but never came up.¹

Premature pits also failed to grow for Mr. H. E. Bidwell and Dr. J. C. Arthur.

In August, 1887, on the farm of T. J. Shalleross, Locust Grove, Md., I saw about thirty seedlings planted by themselves in a garden and said to have grown from premature peaches. Mr. Shalleross himself gathered and planted the pits. The trees were somewhat smaller and seemed of a lighter green than those in the nursery rows, but were apparently healthy. The under-size was thought to be accounted for by the fact of a late spring planting, pits being usually put out in the fall. Part of these seedlings were inoculated in my presence with diseased buds, part with healthy buds, and the rest were left unbudded. In the spring of 1888 some of each sort were sent to me at Hubbardston, Mich., along with several hundred other trees, and set upon my father's place. The packing was admirably done, and all the trees were in excellent condition, except those which grew from the diseased pits. These did not appear to have suffered in transit, but were, nevertheless, in a very feeble condition, having not wintered well. Twenty-three of these trees were received, and 19 were carefully set under my own direction, but when examined in June all of them were dead. Three were not considered promising enough to set. Of the other trees set at this time only an exceedingly small per cent. had died.

From field examinations I am also reasonably confident that seedlings sometimes grow from premature peaches, having seen them under diseased trees so many times as to make it improbable that all of them grew from chance healthy pits.

Nevertheless, from my own experiments, I think it is certain that a great part of the premature fruit will not produce seedlings. In the autumn of 1887 I carefully selected the pits of 2,070 premature peaches. Thomas J. Shalleross, of Locust Grove, Md., and Smith & Brother, of McAllisterville, Pa., also collected for me, making a total of 3,104. These pits were sent in small lots to trustworthy persons to determine what per cent. would develop into diseased trees. Most of these pits were planted out in the fall, as in ordinary nursery culture. The following is a synopsis of results:

¹ Letter of September 20, 1887.

TABLE XVII.—*Showing results of attempt to grow trees from the pits of premature peaches gathered in 1887.*

When, where, and by whom collected.	Variety, age, and condition of trees.	When and to whom sent.	When and where planted, and number planted.	Results up to October, 1888.	Remarks.
August, 1887; Locust Grove, Md.; T. J. S.	Various sorts; young trees; badly diseased.	October 10; Department of Agriculture.	November 2, 1887; Department grounds, 357.	Only five grew. Trees are healthy. Smallest is 32 inches high and 2 inches in circumference at base; largest is 56 inches high and 4 inches in circumference at base. All are branched widely from ground.	These trees will be kept under observation.
August, 1887; Locust Grove, Md.; T. J. S.	Various sorts; young trees; badly diseased.	September 26; Prof. L. H. Taft, State University, Columbia, Mo.	Experiment station grounds. Pits carefully stratified in fall. 100.	None grew.	Pits cracked in spring; All but two were decayed and these two were rotten at end and failed to germinate.
August and September, 1887; McAllisterville, Pa.; Smith & Bro.	Late Crawford and Smock; young trees; first year of disease.	September 26; Prof. L. H. Taft, Jr., Agricultural College, Michigan.	October 29, 1887; College grounds, 227.	None grew.	
August and September, 1887; McAllisterville, Pa.; Smith & Bro.	Late Crawford and Smock; young trees; first year of disease.	October 10; Prof. James Troop, Purdue University, Lafayette, Ind.	Experiment garden; planted October 26. 175.	Eight grew. Trees are now about 2 feet high and look healthy.	Examined in April; few pits had cracked during the winter. The kernels were "all somewhat shriveled."
August and September, 1887; McAllisterville, Pa.; Smith & Bro.	Late Crawford and Smock; young trees; first year of disease.	September 26; Prof. L. R. Taft, Columbia, Mo.	September 26; Charles F. Weller, Hubbardston, Mich.	None grew.	Pits were cracked in spring; all decayed.
August and September, 1887; McAllisterville, Pa.; Smith & Bro.	Late Crawford and Smock; young trees; first year of disease.	September 26; Charles F. Weller, Hubbardston, Mich.	Autumn. In his garden. 140.	None grew.	
September 5, 1887; Mardella, Del.; E. F. S.	Beers' Smock; young and thrifty trees; first year of disease.	September 26; R. K. Smith, Hubbardston, Mich.	Autumn. In his garden. 140.	None grew.	Quite a good many were dug and examined in June; kernel dead.
September 6, 1887; Rising Sun, Del.; E. F. S.	Beers' Smock; old trees, but not decayed; first year of disease.	September 26; R. K. Smith, Hubbardston, Mich.	Autumn. In his garden. 140.	None grew.	

TABLE XVII.—*Showing results of attempt to grow trees from the pits of premature peaches gathered in 1887—Continued.*

When, where, and by whom collected.	Variety, age, and condition of trees.	When and to whom sent.	When and where planted, and number planted.	Results up to October, 1888.	Remarks.
September 6, 1887; Rising Sun, Del.; E. F. S.	Beers' Smock; old trees, but not decayed; first year of disease.	September 26; Charles W. Garfield, Grand Rapids, Mich.	Autumn. On the farm as in ordinary nursery practice. 140.	None grew.....	Pits cracked in the spring. All but one were decayed, and this one did not germinate.
September 6, 1887; Rising Sun, Del.; E. F. S.	Beers' Smock; old trees, but not decayed; first year of disease.	September 26; Prof. L. R. Taft, Columbia, Mo.	Experiment station grounds. Carefully stratified in fall. 140.	None grew*.....	Concerning the three lots sent to Professor Bailey. Mr. C. S. Crandall, foreman of the gardens, writes as follows: "The three lots were separately stratified with sand October 29, 1887, and buried in sandy soil. Last April they were brought in. The pits from Pennsylvania and those from Maryland were cracked. No means that could be any possibility germinate were found and none were planted. The lot from Delaware was planted without cracking. None grew."
August 4-11, 1887; Still Pond, Md.; E. F. S.	Various sorts; young trees; first year of disease.	August 13; Prof. L. H. Bailey, Jr., Agricultural College, Mich.	October 29, 1887. College grounds. 175.	None grew.....	
September 5, 1887; Magnolia, Del.; E. F. S.	Beers' Smock; young trees; first year of disease.	September 26; Prof. L. H. Bailey, Jr., Agricultural College, Michigan.	October 29, 1887. College grounds. 150.	None grew.....	
August 28, 1887; Felton, Del.; E. F. S.	Red-checked Melacoton and Smock; old and young trees; badly diseased; first or second year of attack.	August 30; Prof. William R. Lazear, Stat. University, Columbus, Ohio.	September 26; Prof. William R. Lazear, Stat. University, Columbus, Ohio. Experiment station grounds. 360.	None grew.....	

September 5, 1887; Mag- nolia, Del.; E. F. S.	Beers' Snock; young trees; first year of disease.	September 26; Prof. Will- iam L. Lazarby, Colum- bus, Ohio.	September. Experiment: None grew.....
September 2, 1887; Do- ver, Del.; E. F. S.	Various sorts; old trees; first or second year of disease.	October 10; Prof. James T. C. Pop, Purdue University, Lafayette, Ind.	Experiment garden. Planted October 26. 325.

Examined pits in April.
Few had cracked during
the winter. The kernels
were "all shriveled."

* Professor Taft writes as follows, under date of September 25, 1888, concerning the pits sent to Missouri: "The pits from yellowed peaches received by me at Columbia from you were stratified very carefully soon after they were received. This spring I examined them, and as they showed no signs of cracking, I cracked them with a ham-
mer, and found all but two of the Mary land and one of the Delaware pits decayed, and these were rotten at the ends. I planted them, however, but none of them grew,
decaying instead of sprouting.
The same day that I stratified your pits I heeded out about 3 feet from them, 2 bushels of seedling pits, treating them in the same manner. From them I obtained
five thousand seedlings, every one of the stones cracking during the winter.
In some of your pits I found the meat to be dry and shriveled, while in others it was soft and watery, the cotyledons in every case being badly decomposed."

My own collectings and transmissions were made with the utmost care, so that no mistake might occur. None but premature red-spotted peaches were gathered, and in most instances these were of normal size, and from trees which manifested no symptoms of disease till 1887. The collections by Mr. Shallcross and Smith & Brother were from young trees recently diseased, and were made, I believe, very carefully. It seemed, therefore, that these pits must be in the best condition for growing. The results show that only about five-tenths of 1 per cent. grew. Of my own collecting only two grew, *i. e.*, less than 1 in 1,000. Judging from these experiments a majority of premature peach-pits will not grow. I also infer this from the fact that many which I have cracked and examined, especially those from trees diseased more than one season, either contained no kernel, or one with a dead embryo. If this holds good for all localities and seasons, then one supposed source of danger is greatly lessened. However, it will not do to base a sweeping conclusion on the experiments of a single year. They should be repeated several seasons on a large scale.

It is also possible that enfeebled seedlings may grow from peaches borne on the yet apparently undiseased portions of affected trees. No experiments have been made to determine this point, but in the present state of our knowledge it is certainly wisdom to procure pits from uninfected districts or at least from orchards containing no diseased trees. In this way one possible source of danger will be avoided. Many nurserymen now procure seed for nursery stock from infected districts. In such cases there is always a liability of getting pits from diseased trees, even when the greatest care is used, and this liability is largely increased when the seed is bought indiscriminately from dry-houses and canning establishments, with no previous inspection of the fruit. There can, I think, be little doubt that a majority of the diseased orchards in New Jersey, Maryland, and Delaware, were budded on seedlings grown from pits collected in districts where yellows prevailed. I know this to be true of many orchards. A portion of even the so called "natural" or "Tennessee" seed is grown on the Delaware and Chesapeake Peninsula and fraudulently sold to nurserymen for the genuine article. Sometimes this spurious seed is shipped to Tennessee and then reshipped to points farther north; sometimes it never gets any farther south than Philadelphia or Baltimore. I have this information from several reliable sources. I do not know how one can be certain of procuring genuine Southern pits from unbudded trees unless he collects them himself, or deals directly with Southern men of well-established character. Moreover, in recent years, the demand for this kind of seed has probably exceeded the *entire available product* of the small unbudded orchards of Tennessee and other Southern States. In the South as well as in the North the large orchards are of choice budded fruit. Finally, granting that some pits are genuine and come from Tennessee there is in this fact no absolute guaranty of safety, because yellows probably occurs to

some extent in that State, and is nowhere restricted to budded fruit. Nurserymen will probably do best by personally inspecting orchards in fruit season and selecting pits from such as are entirely healthy. If these orchards are in regions where yellows has not appeared, so much the better. Nurserymen have received much harsh criticism, but as a rule I believe them to be an enlightened and honorable class of men, ready to adopt any methods likely to be for the interest of their patrons. Quite often I have found them better informed on horticultural questions, yellows included, than any other persons in the community.

DISEASED BUDS.—Can yellows be transmitted by budding? This question has an important bearing on the aetiology of the disease. If it can be answered in the affirmative, I do not see how it is possible to avoid the conclusion that yellows is a contagious disease.

So far as I know, William Prince was the first to assert that peach yellows can be spread in this way. That was in 1828. He states explicitly that a healthy tree when inoculated from a diseased one becomes itself diseased, but he does not state when, where, or by whom this was observed.¹

In the spring of 1831 Noyes Darling, a most careful observer, inoculated a healthy young tree with a bud from a diseased one. The bud died and the stock remained healthy.² The evidence in this case is simply negative.

In 1841 Robert Sinclair, another careful observer, states that on one occasion, before he had a nursery, he inserted into healthy peach stocks twelve buds from a favorite, early purple peach, which he suspected of yellows but desired to preserve. The buds were taken from the healthiest branch, but when they had grown about 3 feet they showed the disease so plainly that they were pulled and burned.³

In 1842 or 1843, discussing yellows in his "Catalogue," A. J. Downing states that it may be transmitted from infected trees by grafting or budding, but we are not told whether this statement was a result of his own observation. Mr. Downing often appropriated and digested the statements of other men without credit, and this may have been an instance of that kind.

In December, 1844, Noyes Darling, who had been making additional observations and experiments since 1831, reported again as follows:

If a bud from a diseased tree is inoculated into a healthy stock, whether peach, apricot, or almond, the stock will become diseased and die. * * * I took some buds from a tree having symptoms of yellows, and inserted part into peach, part into apricot, and part into almond stocks. Some of the inoculations took well, but all showed marks of disease next season. The peach and almond stocks with their buds died the second winter after inoculation. One apricot stock lived five years, but its peach top grew in that time to be only about 3 feet high.⁴

¹ *Loc. cit.*

² *New York Farmer and Horticultural Repository*, N. Y., 1831, pp. 9 and 10.

³ *Magazine of Horticulture*, 1841, p. 212; see also *Farmer's Register*, 1841, pp. 357, 358.

⁴ *The Cultivator*, Albany, N. Y., 1845, pp. 60-62.

It is to be regretted that some account of the symptoms which preceded the death of these trees was not given. This would have made a more complete case.

Two or three years later a writer in *The Farmer and Mechanic* states that from his own observation and experience he is led to believe that the disease has been aggravated and spread by budding from trees containing incipient seeds of the disease not yet externally developed. A bud may be taken from a tree which is apparently sound but not really, and after a time both trees will become affected.¹

In 1849, S. W. Cole, an unusually careful writer, states that "healthy trees, inoculated with buds from diseased trees, soon become affected also." He speaks guardedly on most points, but dogmatically on this one—says it is a "well-established fact."²

In 1853, J. J. Thomas, another careful writer, says of peach yellows, "It is quickly induced by inserting the bud from an affected tree into a healthy stock."³

Dr. F. S. Dunlap states that from experiments in his garden and on his farms, principally between 1865 and 1886, he is perfectly sure that yellows can be transmitted by budding. He has inoculated from twenty-five to thirty trees in different years, "with buds taken from yellows trees with the result, invariably, of giving yellows to the tree budded." The inoculated trees grew from pits of "natural" fruit procured in North Carolina, Virginia, Tennessee, and Kentucky.⁴

Dr. Henry Ridgley is also authority for the statement that yellows may be produced by budding. Many years ago, when not so well acquainted with yellows, he inoculated quite a large number of seedlings with buds procured from a tree which bore choice-looking prematures. All these trees died of yellows within a few years. None lived long enough to bear fruit.⁵

Hon. T. T. Lyon also states that when yellows was first introduced into Michigan it was budded into seedling trees and distributed in this way. At Benton Harbor, an Early Crawford tree, imported from New Jersey, ripened its fruit in advance of the usual season of that variety. "In ignorance of such disease this was treated as a sport, and the tree was literally cut in pieces to supply buds for propagation."⁶

In 1882, G. H. La Fleur, of Millgrove, Mich., undertook to settle the infectious nature of yellows by experiment. Concerning his experiments he writes as follows, under date of September 30, 1887:

The following August (1882) I budded thirty-two sound stocks to buds taken from a tree showing yellows in the fruit but not in the tree itself. Eight of the buds started the following spring. Four only started one-half inch to one inch, and then

¹ Quoted in *Farmer's Cabinet*, 1848, pp. 182, 183.

² *American Fruit Book*, Boston and New York, 1849, p. 185.

³ *American Fruit Culturist*, Auburn, N. Y., 1853, p. 285. Mr. Thomas repeats this statement in the last edition of his book, N. Y., Wm. Wood & Co., 1885.

⁴ Letters of September 2, 1887, and January 17, 1888.

⁵ Conversation, August, 1888.

⁶ Letter of January 19, 1888.

Failed to grow and soon died; one bud grew 3 inches; one a little over 4 inches; two buds grew 8 and 10 inches high; all turned yellow and looked sickly. In August of the same year I pulled up the trees and burned them. After doing this it occurred to me that the stocks should have been left in the ground to grow, to test the question as to whether yellows could be communicated to healthy stocks by inserting diseased buds. I hope you will test thoroughly this last point, as that is of great importance to know. If the disease can be communicated to healthy stocks by inserting diseased buds, that fact would prove yellows to be a contagious disease and not the result of starvation or any lack of elements in the soil.

In this case an opportunity was certainly lost. Had Mr. La Fleur left the trees for a few years, he would have learned beyond question whether yellows can be communicated to the stock by the insertion of diseased buds. This is the very gist of the inquiry. A diseased bud could not be expected to make a very healthy growth, and yet it might not transmit disease to the stock. If it did, it would, as Mr. La Fleur states, be good proof of the contagious nature of yellows.

I have presented as strong an array of testimony in favor of this belief as I could find, yet, in a scientific sense, it must be confessed to be stronger by virtue of the names cited than by the circumstantial nature of the statements. In studying these statements critically it seemed to me there were broken links in the chain of evidence, and chances for error. Most of the statements left much to be desired in the matter of detail, as to when, where, and under just what circumstances these results were obtained. I was the more inclined to doubt some of these statements from the well-known fact that errors often pass current from writer to writer, unchallenged for decades, especially when first expressed dogmatically by some strong man.

My own experiments were begun with a view to throwing light on some of the uncertain points, especially on the question of whether the disease could be transmitted from inserted buds to healthy stocks. I had no well-established belief that the inoculations would succeed, but had a strong desire to confirm or invalidate the statements already made. Every precaution was taken to avoid sources of error. I collected the buds myself from trees which bore premature red-spotted peaches and the characteristic diseased shoots; carried them to the nurseries; watched the operation of budding; and staked off and recorded the location of the trees. The nurserymen on whose grounds these trees were budded also made proper entries in their books so that when the trees were removed there could be no possible mistake. The examinations in 1888 were made by myself unless otherwise stated.

The inoculations were made in August and September, 1887, in Maryland and Delaware. Nearly one thousand healthy trees, five or six months old, were inoculated with the diseased buds as in ordinary budding, and five hundred similar trees were reserved unbudded for comparison. In the spring of 1888 part of these trees were sent to experiment stations or private individuals, and the rest were left in the nursery rows. The following table gives the result of these experiments up to date, so far as observed or reported:

TABLE XXVIII.—Showing results of experiments undertaken in 1887 to determine whether yellows can be propagated by budding.

Stocks.	Buds.	Buds.	Trees.	Summer examination.	Autumn examination.	Results in 1888 stated in per cents.
Number, kind, when, where, and by whom grown.	When, where, and by whom transmitted. Condition on arrival. Witnesses.	When and to whom transmitted. Condition on arrival.				Remarks.
I-202; Suncock seed, from Shalcross.	Four-year old trees, bearing premature peaches and diseased shoots. Buds from characteristic diseased growths. August 12, Bay Farm of James S. Harris, Still Pond, Md. L. V. S. Henry Kristen, and J. S. Harris present.	Left in nursery row.	26; a considerable part with yellows.	40	34 33 32 19	Two buds were inserted into the larger trees. Nearly all took, but most failed to grow. Of the fifty-seven which grew, thirty-two developed yellows, twenty-five were healthy (<i>Antrus</i>), but ten of the twenty-five showed diseased shoots on the stock. Five hundred and forty-two trees from adjoining rows in the same nursery were examined for comparison; all healthy.
III-198; Tennessee seed, 1887. Locust Grove, Md.	Four-year old tree, bearing diseased shoots, and peaches. August 12, Thomas J. Shalcross.	26; a considerable part with yellows.	40	36 33 32 19	Two buds were inserted into the larger trees. Nearly all took, but most failed to grow. Of the fifty-seven which grew, thirty-two developed yellows, twenty-five were healthy (<i>Antrus</i>), but ten of the twenty-five showed diseased shoots on the stock. Five hundred and forty-two trees from adjoining rows in the same nursery were examined for comparison; all healthy.	
Mr. Shalcross.	Not examined	0	0 0 593.5	One hundred and twenty-six unbudded trees from same nursery were set for comparison. When examined on June 26, 1888, 6 per cent. were dead. The marked difference between I and II is attributable to the different character of the inserted buds.		

When examined in June lot III gave evidence of disease, but owing to the fact that all of the trees were badly dried in transit and had made but a feeble growth, I did not feel like using this lot as the basis for argument, unless further developments should fully warrant me in doing so. Not having seen these trees since June, I am unable to report exactly their present condition. The same remark applies to lots IV and VI, which I have not seen since they were budded.

Neglecting, therefore, all trees which were unfortunately dried in transit, or were not personally examined, or in which the disease may have been derived from the stock, we have left for special consideration in this connection lots I and II. These give unequivocal results.

Lot I, inoculated with buds from characteristic shoots of robust young trees in the first year of the disease, was left in the nursery where budded. The trees were budded in August, 1887, and were examined in August and November, 1888. Most of the inserted buds "took," but only about one-fourth of them grew. Some of these buds developed into shoots which appear to be healthy, and some into diseased shoots. In a few cases the inserted bud developed in a normal way, but the stock became diseased. This was also the case with some stocks on which the inserted bud "took" but did not grow. The infection, whatever it may be, was transmitted from the bud to the stock in about *forty per cent.* of the inoculations, *i. e.*, the previously healthy stocks contracted the disease from the inserted buds and sent out feeble wiry growths, often at a distance of some inches from the inserted bud. This was the point I most desired to establish, because, as already stated, I thought it likely that the inserted buds might grow into diseased shoots and the stock still remain healthy. The evidence of this infection of the stocks could be seen in July, was clear in August, and still plainer in November, when nearly all the winter buds on some of the stock shoots were just pushing under the influence of the disease. Even as early as August 26 per cent. of the infected stocks were dead, and others, then languishing, were dead in November.

Of the entire lot of two hundred trees, only thirty-nine appeared to be entirely healthy in November. From the foregoing table it will be observed that even in August a very unusual number of the trees were dead, and in November the condition of the trees was still worse, less being healthy and more being dead. Early in the season many of these dead trees had put out feeble shoots from the inserted bud or the stock, but these grew only from one-half an inch to three inches and then died. A June examination would have shown fewer dead trees and a much larger number of apparently healthy ones. Even in August the trees marked *doubtful* and *diseased* showed a green and thrifty top, and at a distance gave no more indication of disease than do older trees in the first stage of yellows. As a rule, however, their growth was not as robust as that of trees in the adjoining rows. These neighboring trees are of the same age and stock, and were budded at

the same time, but from healthy scions. The contrast was very striking, and the comparison left no doubt whatever that in this case the disease was due entirely to the insertion of the unhealthy buds (see Photos XXVIII-XXXI).

Lot II, inoculated with buds apparently healthy, but taken from a tree on which were some limbs in the first stage of the disease, was sent to a locality free from yellows. Up to the last of June only one tree showed any suggestion of disease and this was doubtful. Unfortunately, these trees were not examined in the autumn, and their present condition is not known. It is quite possible that they have already developed yellows, or that they will do so after some years. No nurseryman would ever use such diseased and imperfect buds as I inserted into lot I, but the buds inserted into lot II appeared to be well developed and perfectly healthy, and might have been selected for ordinary budding by a careless or unscrupulous man. The future of these trees will therefore be watched with the greatest interest, since it may throw additional light upon the manner in which the disease is distributed. A point very interesting in connection with this discussion is whether trees of the same age and same variety, and from the same nursery, are entirely healthy in one locality and badly diseased in another. I have made some observations on this point, but not enough to be able to speak positively. The evidence, however, favors the belief that such trees are often healthy in one locality and diseased in another, and if further inquiry substantiates this conclusion, it will be an additional reason for thinking that yellows is not always to be attributed to the nursery, but may also spread in other ways. My own view at present is that the first affected tree in any district is always an introduced one, but that when once introduced the disease spreads from orchard to orchard irrespective of the origin of the stocks or buds.

SPREAD OF THE DISEASE BY INFECTED PRUNING KNIVES OR SAWS.—Many persons have asserted that the disease may be propagated in this way. I have no positive evidence on this point; and no experiments have yet been undertaken to settle it, owing to the great amount of work involved in the other examinations and experiments here set forth.

This experiment should be tried carefully on registered limbs in an uninfected district, or if in an infected one then in a larger number of trees and in as healthy an orchard as can be found.

NURSERIES NOT RESPONSIBLE FOR ALL OF THE OUTBREAKS.—On other grounds than those already set forth, I am confident that neither sound stocks nor healthy buds will entirely protect from yellows. The disease does not all come from the nursery. It must have some other means of dissemination. The following are my reasons for this belief:

(1) In the infected districts I could not satisfy myself that the trees of one nurseryman were more subject to yellows than those of another,

although I took great pains in many instances to trace the history of the trees especially if they were young ones.

(2) Some experiments with stocks and buds of a known character seem to show this quite conclusively. In orchard No. 11 of this report special pains was taken to secure healthy trees. This orchard was budded and planted by Walter Morris, cashier of the Farmers' Bank, Dover, Del. He procured the seed from a load of healthy natural fruit, brought into Dover and sold to Mr. Richardson in a year when there was a great scarcity of peaches. They were budded next year, Mr. Morris selecting the scions himself from a healthy orchard which hung very full of fruit. The yellows first appeared in this orchard about four years ago, *i. e.*, four years after budding, and spread very rapidly in 1886 and 1887. I came across a similar case on the farm of S. H. Derby, near Woodside, Del. Mr. Derby selected the pits himself from a very thrifty-bearing orchard, free from yellows, and cut the buds from healthy trees in an orchard where yellows was unknown and where it did not appear until recently, *i. e.*, within the last three or four years. This orchard contains about 10 acres and is nine years old from the bud. The first premature peaches appeared in 1886, *i. e.*, six years after budding and several years after the orchard had fruited. In 1887 I saw many diseased trees in this orchard, and there were new cases in 1888.

(3) The fact that orchards frequently make a vigorous early growth and then bear peaches for fifteen or twenty years, often in enormous quantities, before showing symptoms of yellows.

I have observed many such cases. A few may be cited.

Orchard No. 16 of this report is thirty-three years old and has been enormously productive, having yielded its last crop in 1888. This orchard was over twenty years old when yellows first made its appearance in it, and it did not suffer materially from the disease until some time after 1880.

An orchard owned by J. Frank Wilson, Still Pond, Md., is twenty-five years old and contains about three hundred trees. Yellows first appeared in 1886 in two trees only. When I saw the orchard in 1887 it contained about twenty diseased trees. In 1888 there were a number of new cases. This orchard has been productive; it bore some fruit in 1888. The trees lived healthily for twenty-two years, during the last four of which yellows was present in another orchard on the same farm, No. 4 of this report.

An orchard of 70 acres owned by James Hurdd, Locust Grove, Md., is nineteen years old and has borne thirteen full crops of peaches, the last one being in 1888. Mr. Hurdd assured me that this orchard never bore a premature peach or showed any signs of yellows until 1884, *i. e.*, it was entirely free from disease for the first fourteen years (fifteen from the insertion of the bud). When I saw this orchard in 1887 about two hundred trees were diseased, and about five hundred more had been cut down in previous years. Many new cases appeared in 1888.

In riding past I counted, in the outer rows, next the highway, over one hundred and twenty affected trees, which were blazed with an axe and ready to be cut down. A young orchard on the same farm is diseased quite as badly as this old one, although it only bore its first peaches last year and its first crop this year. These orchards are but a short distance from No. 7 of this report.

In 1887, at Felton, Del., George W. Killen's old orchard of about 10 acres contained nearly five hundred diseased trees. This orchard is twenty-two years old, and has been productive. Mr. Killen assured me that he never had any premature peaches or diseased trees until 1884, and that year only a few trees were diseased. When I saw the trees many of them were badly affected, bearing premature red-spotted peaches, and an abundance of the characteristic shoots on trunk and main limbs.

The same year near Frederica, Del., Rev. William H. England's old orchard of about 5 acres contained nearly two hundred and fifty diseased trees. They hung full of premature, small, red-spotted, insipid, worthless Melocotons and Old Mixons. Many of them also bore the diseased shoots. This orchard was then twenty-one years old. According to Fred. T. Harrington, the tenant, the disease had been in the orchard only five or six years, appearing the first year in a few trees only. In other words, the orchard was perfectly healthy during the first fifteen years of its existence.

In 1887, on the farm of J. J. Rosa, near Millford, Del., I saw a number of peach trees about thirty years old. They were of great size, the largest having a girth of 42 inches at 1 $\frac{1}{2}$ feet from the earth. All but two were healthy. These two bore premature peaches in 1887 for the first time, and at the date of my visit were well provided with the characteristic diseased shoots.

It seems almost impossible to believe that trees, which are the picture of health when young, and which continue to appear vigorous for three or four years, contain within themselves, in a dormant state, all the elements of disease, yet such is the case, if the yellows is propagated only by diseased stocks and buds. For the sake of argument, in the absence of direct proof to the contrary, it may be admitted that trees which premature their *first* fruit have in every instance been diseased from the beginning, no matter how healthy they *appeared* to be. But what shall we say of trees which succumb after having borne several crops of healthy peaches? It is extremely doubtful whether such trees contracted the disease in the nursery. Finally, it passes the bounds of probability that a germ or anything of kindred nature should remain dormant in a tree *fifteen or twenty years*, that tree meanwhile being taxed to its utmost in the production of fruit, and often exhausted and injured by over-production.

There can be no reasonable doubt that in orchards over five years old the disease is due to some unknown local influence, and not to anything

on or in the trees when procured from the nursery. I am the more inclined to this view from the fact that when symptoms of yellows are once manifest in any branch the whole tree becomes involved in a comparatively short time; *i. e.* within one or two years. In other words, the disease is virulent, and does not remain dormant in one branch very long after it has appeared in another.

MECHANICAL OR VITAL INJURIES.

INJURIES BY MEN OR QUADRUPEDS.—A belief, current in some parts of the country, attributes yellows to any severe injury of trunk or roots, such as might be made by careless cultivation, or by rabbits, mice, etc. This belief arose, no doubt, from confounding a yellow appearance of the foliage with genuine yellows. These injuries are all on a par with those inflicted by the peach tree borer (*Egeria exitiosa*, Say), and what I shall say about the latter will apply to these also.

INJURY BY BORERS.—The larvae of *Egeria* devour the inner bark of the peach, usually at or just beneath the earth's surface, often entirely girdling the tree. This insect is much more common than *Scolytus*, which I have not observed upon healthy trees, and is the only one worth mentioning in this connection.

Borers are so common and so destructive to the peach tree, and have so frequently been accused of causing yellows, that, while I had no faith whatever, I nevertheless gave particular attention to this theory both in 1887 and 1888. My observations show clearly that while they kill or seriously injure many trees, especially on sandy soil, they have nothing whatever to do with the yellows. Some of my reasons for this conclusion are as follows:

(1) Borers have been prevalent for many years, and often very destructive in localities where yellows has never appeared; *e. g.*, Washtenaw County, Mich.; Accomac County, Va.; Sussex County, Del.

(2) Borers are much more prevalent on sandy soil than on heavy loam or clay. But yellows is equally destructive on the latter. I observed this fact repeatedly in Maryland and Delaware. Those owning orchards on sand are obliged to search for borers once or twice each year. Those whose orchards are on clay often neglect to "worm" their trees for several years together without evil results.

(3) In 1887, in orchard No. 6 of this report, I found the collars and crowns of many trees had never been injured in the least either by borers or by bruises of any sort; yet these trees were suffering from yellows. The earth had been dug away from about one thousand trunks on the east side of the orchard, preparatory to the annual search for borers, but so few were found, that it was not thought worth while to examine further. Almost the only injuries I saw were small hacks made in removing the earth. Moreover, the foliage of the orchard nowhere gave any evidence of borers, and I was informed that this insect had never been troublesome. Notwithstanding this fact, three hundred and

fourteen trees became diseased by yellows in 1887, and an additional three hundred in 1888.

(4) In 1887, in orchard No. 7 of this report, I very carefully examined the collar and trunk roots of seventeen trees which were suffering from yellows. Six had been severely injured, by borers or bruises; nine had been slightly injured; and two had never received bark injuries of any sort. Healthy trees in the same orchard were also found to be injured by borers and bruises; while those diseased by yellows did not seem to be affected proportionately to the extent of the injury.

(5) According to Mr. William Hudson, orchard No. 8 of this report was never much injured by borers.¹ For its present condition see Table VI and Photo. XI.

(6) In 1887, in orchard No. 12 of this report, I found seven trees unmistakably diseased by yellows which had no borers and never had any, and had never received injuries of any sort on the trunk, collar, or trunk-roots.

(7) In 1887, in the southwest corner of orchard No. 14 of this report, six healthy and six diseased trees (numbered 1 to 12 on Map IV) were very carefully examined for borers and bruises. Four of the diseased trees were entirely free; two were slightly injured. Four of the healthy trees were entirely free; two were slightly injured. In 1888, three of the six healthy trees became diseased. These were three of the four trees which had never been injured. The entire orchard appeared to be very free from injury by borers. The trees were "wormed" in August, 1884, 1885, and 1886, but not many borers were found. None have been allowed to remain in the trees.

(8) The two old orchards of Charles Wright, Seaford, Del., have suffered severely from borers for years, but yellows has never appeared. He now examines his trees twice a year, and says he would lose them if he did not. This year out of some trees he took as many as twenty borers.

At E. B. Emory's, in Spaniards' Neck, Queen Anne County, Md., a region yet almost entirely free from yellows, I saw a few trees which might throw doubt on the relation of borers to yellows were it not for the facts already cited.

In a block of five hundred trees, first examined in 1887, I found two or three hundred which were more or less dwarfed and sickly looking. Several of these trees were suspicious, but I saw no premature peaches, and could not say positively that any were suffering from yellows. The remainder of the block looked healthy, as did all the rest of the orchard, and all the other orchards on that farm and on all the farms in the Neck. Some of the trees had suffered from borers, but after examining sixty I came to the conclusion that only a very small percentage had been seriously injured. In forty-two I found no indications of borers; but in this case my examination was not exhaustive, and I may have

¹ Orchards No. 2 and 10 have been considerably injured by borers,

overlooked some. These trees may also have suffered from root aphides, as they came from a region where the nurseries were badly injured by this insect some years ago. Anyway this block, in the middle of an otherwise healthy orchard, presented a very striking contrast. The trees on each side were of the same age, but procured from other localities.

In the fall of 1887 or spring of 1888, thirty or more of the worst of these trees were cut back so that nothing remained save the trunk and the stubs of the main limbs. When examined in the summer of 1888, I found some healthy; some dead; and some diseased in the following way: The stubs of the limbs of twelve trees were covered with a pale yellowish-green much branched dwarfed growth, identical with that shown in Photo. VI, but more tufted and compact. Six of the most badly affected trees were dug out and examined very carefully. They were all much dwarfed, the trunks at the collar being only about 3 inches in diameter, although four years old (five years from bud). I saw no root aphides, but each of these six trees was very badly infested by borers. From one trunk I removed seven, and from none did I take less than two. Three of the trees were entirely girdled; two were very nearly girdled; and the other had sound bark on less than one-third of its trunk-circumference at the collar.

This is the only instance discovered where a growth strikingly like yellows, if not identically the same, seemed to be closely associated with borers. The evidence in this case is of course not conclusive. I had my doubts about some of these trees in 1887, and revisited the orchard to settle them. Moreover, in 1888, in this block I found undoubted yellows in one tree, a small Mountain Rose replant of 1887, or possibly 1886. This bore spotted premature peaches but healthy spring foliage and no diseased shoots. I also saw yellows in another young orchard in that vicinity which I know to have been free in 1887.

INJURIES BY ROOT APHIDES.—An aphid corresponding nearly to Koch's figures and description of *Aphis Chrysanthemi* is frequently found upon the roots of peach trees, especially in New Jersey, Maryland, and Delaware. It is I think identical with a form occurring upon the shoots and young foliage. This, however, I have found only twice in two years, and then but sparingly, and not in the perfect state. No one appears to have collected the winged insect, and it is possible it may prove a distinct species.

This insect has been known to New Jersey peach-growers more than fifty years, and has been on the Delaware and Chesapeake peninsula fully as long. It was at Chestertown, Md., in 1860,¹ and destroyed thousands of trees in various parts of Kent County between that date and 1875.

James S. Harris, of Still Pond, states that he has been familiar with this insect for many years, and until recently has lost more trees by it than by yellows.

¹ *The American Farmer*, Baltimore, Md., 1875, p. 100.

At Chestertown in the orchard of Colonel Wilkins it was particularly destructive in 1874 and 1875. In 1875 in an orchard of 15,000 Early Beatrice hardly 300 of the original trees remained, there having been successive plantings to the number of nearly 20,000 on account of injury by aphides.¹

This aphis was also very abundant at Denton, Md., in 1874 and 1875² and at Bridgeville, Del., about the same time.³ Thousands of young trees were killed or badly injured. Probably it was destructive in many other parts of the Peninsula at this time.⁴

This aphis has also proved a great pest to orchards and nurseries in various parts of New Jersey.⁵ But I have heard no complaint from western New York or Michigan.

As already noted in Part II, stunting is one of the marked symptoms of the presence of this aphis. If trees are much dwarfed, and there are no injuries by borers, aphides are almost certain to be found upon the roots. It is not uncommon to find trees which are only one-half or one-third the size of their fellows solely because their roots are infested by this aphis. Sometimes the second or even the third year after planting they are but little larger than when set (see Photos XXVI and XXVII). As a rule young trees suffer more than old ones. In some instances, especially in trees which have begun to bear, I have found no dwarfing, and yet have discovered aphides on the roots, but only in small numbers.

On the young and tender roots they settle in colonies, heads together and beaks thrust into the soft tissue, from which they abstract the juice. This constant sucking renders the root extremities flabby, and death ensues, whereupon the colony migrates to another root, or, what is more likely, is carried there by the yellow ant (*Lasius clariger*, Rogers),⁶ which is a constant attendant. This pumping of root juices, with the consequent destruction of thousands of root extremities, acts somewhat like severe root pruning. If too many roots are removed the tree dies; if not so many, it is dwarfed.

The foliage of such trees is greatly dwarfed. It also presents a miserable reddish or yellowish-green aspect, with more or less rolling and curling, and purple-spotting of the edges of the leaf. This appearance is known as "Frenching," and is quite constant on young trees, although I have known instances in which it did not occur. Ordinarily, from the appearance of the parts of the tree above ground, one is very safe in diagnosing root aphides, as I know from repeated trials.

When I first began field-work I was surprised and puzzled by occa-

¹ *The American Farmer*, Baltimore, Md., 1875, p. 278.

² *Ibid.*, 1874, p. 331; 1875, p. 100.

³ *The Gardeners' Monthly*, 1880, p. 206.

⁴ *The American Farmer*, Baltimore, Md., 1874, p. 213; and *Ibid.*, 1875, p. 25.

⁵ Peach Root Aphis, Charles Black, *The Gardeners' Monthly*, Philadelphia, Pa., 1884, p. 303.

⁶ Kindly determined by Dr. Henry C. McCook.

sional reports of "dead spots" in orchards, *i. e.*, places where peach trees will not grow. Afterwards, I examined many such spots and satisfied myself that the trouble is due to root aphides, at least in Maryland and Delaware. I have seen spots of soil, not noticeably different from the rest of the orchard, on which the second and even the third planting languished and finally died with symptoms such as I have detailed. This languishing is frequently confounded with yellows, but it is entirely different. Sometimes by repeated trials healthy trees have been grown in such places.

I believe the aphides are retained in such spots or transported to other localities by the yellow ant which I have found constantly associated with it, and which appears to be the only species taking any interest in this aphis. I have frequently found the eggs, larvæ, and pupæ of this ant in sandy soil under peach trees; and have seen the ants take the aphides very tenderly in their jaws and remove them to places of safety. In one instance, while digging in orchard No. 16, I placed a small root containing a colony of about thirty aphides on the ground at some distance from the tree, intending to put them into alcohol. Before I discovered what they were doing, yellow ants had carried away all but four or five, and were still carrying. I saw one ant come and go three times, each time taking away an aphis in its jaws, and each time very tenderly. Undoubtedly this aphis is carried from root to root and tree to tree by these yellow ants.

What makes this subject interesting in connection with peach yellows is the theory that that disease is due to the depredations of this insect. In view of the ravages of *Phylloxera* in vineyards, it is certainly an attractive theory, and one to which I have given much thought.

Some time after I began my field work, I found them in a number of orchards on roots of trees suffering from yellows. At first I was much perplexed, thinking I might have overlooked their presence on many roots previously examined. This discovery led me to make many exhaustive and very tedious underground examination, in some cases 50 to 75 cubic feet of earth being turned over under a single tree, all the roots and rootlets therein being examined very minutely, often with a triplet. These examinations somewhat restored my confidence in previous work. In a number of orchards I found trees in various stages of yellows, on the roots of which the most patient and prolonged search revealed no aphides. The yellow ants were also absent from the soil. This, however, is not conclusive, for it is well known that the *Phylloxera* generally abandons the roots of badly diseased vines for healthy ones, and the same might be true of this aphis. Although the roots gave no positive indication of the previous presence of these insects, I could not deny that they might at some time have been present and have deserted these roots for those of other trees, which would in turn fall a prey to yellows, to be in turn deserted. While this could not be denied it nevertheless seemed improbable, because on the roots of large trees I never in any instance found them in numbers sufficient

te do much injury. Only one experiment looking toward the settlement of this point was undertaken. In 1887, in the southwest part of orchard No. 14 of this report, the roots of twelve trees, numbered 1 to 12 on Map IV, were very systematically examined, an entire day being spent in the digging. Six of these trees had become diseased by yellows in 1887, and six were entirely healthy. I found aphides in small numbers on a few of the roots of 1, 3, 4, 5, 6, 7, 9, 10, and 12. In the earth under the other trees (two diseased and one healthy) I saw no yellow ants, and found no aphides on their roots. In August, 1888, these trees were re-examined; 4, 8, and 9 had become diseased, while 5, 6, and 7 continued to be healthy; *i. e.*, No. 8, on which no aphides were found in August, 1887, had become diseased, and Nos. 5, 6, and 7, on which they were found, had not become diseased. So far as it goes, this result is opposed to the aphis theory.

A much stronger objection is the well-established fact that trees whose roots have been seriously infested with aphides often recover or linger on for years, with none of the symptoms of yellows. Young trees the first or second year out from the nursery often suffer severely from this root aphis and afterwards recover, making healthy orchards. I have seen a number of such orchards.

Another serious objection is that at Denton, Caroline County, Md., and at Bridgeville, Sussex County, Del., this root aphis has been more or less destructive since 1870, at times very destructive, while so far as known no trouble from yellows has ever been experienced at either place, both localities now being free, or nearly free, from that disease. This insect has also seriously injured trees at Seaford, Del., in the orchards of Colonel Martin, without having caused yellows. Some of the trees recovered, others died.

One point remains to be discussed—that is, whether under any circumstances the root aphis may give rise to symptoms resembling yellows. The symptoms already detailed are the common ones. I have heard it asserted that the aphis causes peaches to ripen prematurely, and the well-known fact that such ripening may be brought about by severe root-pruning¹ lends some countenance to the belief. My examinations, however, developed no proofs. I have seen green, healthy peaches on trees badly infested by root aphides, and when I have found this insect on the roots of trees bearing premature peaches it has never been under such circumstances as to render it certain, or even probable, that it was the real cause of the disease. The only point about which I have any doubt is whether such growths as that shown in Photo. VI can ever result from attacks of the aphis. This photograph was made in autumn from a tree set in spring, and the top shown is the only growth it made during the entire season. The roots were infested by this aphis, and seemingly to an extent fully sufficient to cause the symptoms observed. The question is, Were they the cause of the diseased top, or

¹ See Dr. Hull's account in *The Prairie Farmer*. Quoted in *The Cultivator and Country Gentleman*, 1871, p. 378.

was the tree suffering from two distinct evils? In orchard No. 11 of this report (same farm) all the replants of 1887 showed the same diseased appearance as this tree, and in four out of five trees which were examined I found root aphides in considerable numbers, and had reason to think that they had been present on the roots of the other tree. These insects were also found upon the roots of older trees in the same orchard.

In an orchard owned by John Stokes, Still Pond, Md., and containing trees diseased by yellows, I also saw two resets of 1887, with tops of identical appearance. On the roots of one I found aphides, and on the roots of the other some indications of their former presence.

On the other hand, on the farm of Henry Krusen, Still Pond, Md., out of two thousand trees set in 1887, I saw about thirty that had the same appearance. Eight of the worst ones were examined very carefully for aphides and the yellow ants, but neither were found. Two of the trees had been injured by borers, but the rest were free from bark injury.

The only difference which I could detect between the wiry, branched, depauperate growth on these trees and that found on robust older trees, bearing premature peaches, was in the lesser tendency toward autumn growth, and I can not say that even this is a constant difference. When placed side by side with growths from older trees, it was not always easy to distinguish one from the other. I am inclined to believe that where aphides were on the roots the unfortunate trees were suffering from two distinct evils; but some additional observations ought to be made.¹

¹ Buckton reduces *A. chrysanthemi* to *A. cardui*, Linnaeus, but his description of that species does not correspond to this insect.

The underground form of this insect is very broadly ovate, almost heart-shaped; uniformly dark brown or black, and very smooth and shining on the back, as if lacquered.

The antennæ are five or six jointed, brownish, darker toward the tips, the base of the distal joint being obliquely enlarged. Head of usual form; thorax short; abdomen broad and very shiny above, not distinctly mottled or banded in the living insect, smooth except the apex of the cauda, which is provided with a few short bristles. The first and last three abdominal segments are visible on the back, the others are smoothed out and united into a shining plate. The segments are more clearly visible below. Cauda blunt and extremely short, except in alcoholic specimens. Cornicles black, blunt, slightly constricted below the apex, about four times as long as broad. Legs yellow or weak coffee-color, with black markings; smooth except the tibiae, which are provided with a few scattering bristles. The front pair of legs are entirely yellow except the tip of the tibiae, the tarsi, and the claws. In the hinder pairs the femora are yellow, shading into black at the distal end; the tibiae are also yellow, shading into black at the distal end; tarsi and claws black.

The average measurements of the mature apterous underground female are as follows:

	Mm.
Length	1.67
Breadth	1.14
Beak .....	.50
Antenna .....	.70
Cornicles .....	.23
Cauda (alcoholic specimens) .....	.13

The immature insects are weak coffee-color.

INJURIES BY FUNGI.—The peach, like other plants, is subject to the attacks of parasitic fungi; but whether yellows is caused by a fungus or a bacterium remains to be determined. It certainly does not arise from any easily distinguishable cause of this kind.

In the regions affected by peach yellows, I have observed the following species of fungi on the parts above ground:

Taphrina deformans, Tul., on leaves and young shoots, producing the distortion and enlargement known as "curl;" *Sphaerotheca panosa*, Lév., a white felt-like mildew on leaves and young shoots, causing atrophy and death; *Puccinia Pruni-spinosa*, P., producing rust-spots and causing the premature fall of the leaves; *Oidium fructigenum*, Kze. and Schw., causing "rot" in the fruit and "blight" in the twigs; *Cladosporium carpophyllum*, v. Thüm., a surface-growing fungus on leaves and fruit, producing roundish black spots, which are especially frequent on Smock and other late peaches (see Plate XXXII); *Cercospora Persicæ*, Sacc., producing faint frosted patches on the under surface of the leaves, and indistinct yellow spots above; *Cercospora* (?), producing numerous leaf-spots having a dead center and a more or less brightly colored rim of red or purple;¹ *Capnodium elongatum*, B. and Desm., an imperfect form, probably referable to this species, producing black patches on the epidermis, and occurring also in the gum; *Polyporus versicolor*, Fr., on trunk and limbs, principally or wholly on dead or dying wood, and not restricted to trees suffering from yellows, or even to the peach.

Some of these fungi are genuine parasites; others are what De Bary styles facultative parasites; and others are pure saprophytes. None of them stand in any causal relation to yellows, but all are likely to be found wherever the peach is grown in the United States. Those which show any special preference for diseased trees—e. g., *Cercospora* (?)—are not confined to trees suffering from yellows, but occur equally on all trees of low vitality, and are clearly a consequence of impaired vitality rather than a cause.

On the parts underground, I have found no species of *Agaricus*, and have almost never observed any growing in orchards.

Altogether, I have more or less fully examined the root system of fifty-two good-sized trees, all of which were unquestionably diseased by yellows. In every instance the main roots, and all their ramifications down to those smaller than a goose quill, were perfectly sound. The bark was bright-colored and sound throughout, and the wood was free from black spots, rottenness, or signs of decay. Certainly it was not disorganized by mycelial threads of any sort, nor were these commonly present on the surface of the smooth bark. My own observations agree

¹ Very common on diseased trees (see Plate VI, and Nos. 2 and 3 of Plate XXXVII), but not restricted to them. Often the tissue disappears from the center of the spot, leaving a hole. The fungus fruits late in autumn, on both surfaces of the leaf, throwing up many minute tufts of dark brown conidiophores, which bear oval or oblong olivaceous septate spores.

in this respect with the greater part of those heretofore reported. All the larger roots are healthy.

I have, however, sometimes observed a delicate cobweb fungus on the smaller roots and on the rootlets of diseased trees, and have in almost every instance found a large portion of these rootlets dry and dead, even where no fungus could be detected by the naked eye or by the use of a triplet. If peach yellows is in any sense a root disease, I predict it will be found connected in some way with the destruction of the feeding fibers or root hairs of the tree. However, the dead rootlets may be a consequence of the disease rather than a cause, and such a view seems more in harmony with the results of some of the inoculations. I do not feel like pronouncing very decidedly on the matter until the inoculated trees have stood another year, and until I have made the most prolonged and painstaking underground explorations, accompanied by careful microscopic examinations. An additional season in the field and a year of laboratory work would throw much light on the question. Concerning the supposed relation of bacteria to this disease, not enough microscopic examinations or culture experiments have been made to venture any conclusion. On or in the diseased tissues I have occasionally observed a bacillus much resembling that found by Prof. T. J. Burrill¹ and Dr. Manley Miles;² but he would be a very rash man who, on the strength of the occasional and perhaps entirely accidental presence of these all-abounding micro-organisms, should assert their causal connection with this disease. Opinions of any value can not be given until after an exhaustive study of the diseased tissues. No one has yet undertaken this, and no one is now competent to speak with authority.

The rapid spread of the disease in certain years, together with various other facts in its history, lead me to believe that it is due to a parasite of some sort. I have observed much that is very suggestive, and nothing that is inconsistent with such a belief. Even the fact that the disease has existed in some localities for many years without becoming widely destructive is not opposed to this view, but could be paralleled by many references to animal and plant diseases now well known to be of parasitic origin. Certain external or internal conditions of the host plant, or animal, or peculiarities of locality, not yet well understood, are almost always necessary to the rapid dissemination of a parasitic disease. If these are wanting, the disease will be confined to limited areas or to isolated cases.

If yellows is due to some root fungus or other underground parasite, it seems to me it could be entirely prevented by budding the peach upon the roots of trees not subject to this disease, *e. g.*, the plum. If, on the

¹ *Science*, 1880, p. 162; *Tr. Ill. State Hort. Soc.*, 1880, p. 165; *Ann. Rept. of the Sec'y of the Mich. State Hort. Soc.*, 1880, p. 383; *American Naturalist*, 1881, p. 531; *Ann. Rept. of the Sec'y of the Mich. State Hort. Soc.*, 1881, p. 133; *Tr. Ill. State Hort. Soc.*, 1883, p. 46.

² *Conversations*, summer of 1885 and spring of 1888.

contrary, it is due to some parasite living aboveground and attacking the tree through its branches, trunk, foliage, or flowers, then trees budded on plum roots should be as much subject to it as any others.

I have seen some statements to the effect that budding on plum stocks is no protection against yellows; but, having found many errors in the literature of yellows, I am inclined to take all statements with a grain of allowance. The first person to make this statement appears to have been William Prince (*loc. cit.*). He declares that while peach trees budded on plum and almond are less affected by borers, they are equally subject to yellows.

The most explicit statement is that made by Noyes Darling. He says that in 1842 Benjamin Sillman, jr., of New Haven, "procured from Liverpool a considerable number of young peach and nectarine trees *budded on plum stocks*. Some of them were put for standards, and others walled upon a board fence. There had been no peach trees for twenty years on the ground where these were planted. They grew well the first season and appeared in perfect health. The second season some of the peach trees showed symptoms of yellows, and died the third season. At the present time [four years after they were set] no one of the trees, either nectarine or peach, is free from disease. In the garden adjoining that of Mr. Sillman there were diseased trees standing at the time the imported trees were planted out."¹

I believe Mr. Darling's own observations to be perfectly trustworthy. The only points here in doubt would appear to be (1) the nature of the inserted buds, presumably unexceptional, because from England, where yellows is said to be unknown; and (2) the nature of the stocks, presumably plum, as stated, from the fact that in England the peach is very commonly budded on the plum.

Charles Downing also states² that many years ago one of his friends imported 100 peach trees from France. "In two years one-third had the yellows, and the remainder died with it the third or fourth year." These trees were probably on plum stocks, but no date is given and no name, and it is possible that Mr. Downing had in mind the trees imported by Mr. Sillman.

I have found one or two additional references to the occurrence of yellows in peaches budded on plum stocks. The most important is a statement in The Annual Report of the Secretary of the Michigan State Pomological Society, 1874, page 26, to the effect that "in the orchard of John T. Edwards diseased peach trees grafted on plum stalks were entirely destroyed by the yellows without injuring the root at all; below the graft the live healthy root sent out strong plum stalks." I have tried to discover Mr. Edwards and hunt down this statement, but have not been able to do so.

An eastern Maryland correspondent of The American Farmer, 1875,

¹ *The Cultivator*, 1846, p. 141.

² *Ann. Report of the Sec'y of the Mich. State Pom. Soc.*, 1873, p. 38.

page 25, also states that plums, when grafted on peach roots, remain free from disease, although standing within a foot of peach trees which die of yellows.

Peach trees where I have traveled are budded almost exclusively upon peach stocks, and I have not been able to confirm any of these statements. One thousand plum stocks have, however, been inoculated with healthy peach buds in a district now free from yellows, and these will be set in some of the badly-diseased orchards in Maryland and Delaware and the results carefully recorded. The trees from which the buds were taken have also been marked, and will be kept under observation for a number of years, so that if any of them develop yellows this fact may be recorded and given its due weight in estimating final results. If these trees from which the scions were taken remain healthy, while those budded on the plum stocks contract yellows, then underground parasites are excluded, and, if yellows is a parasitic disease at all, the cause must act through the parts above ground. Such a result would also show that the insertion of diseased buds is not a necessary factor in the production of yellows.

From the fact that the disease first appears in the fruit, and occasionally only in one or two peaches, it has been thought that the yellows might be due in some way to diseased pollen or to bacteria which find an entrance through the moist unprotected stigma. On this theory the contagium is supposed to enter the tree in the spring of the same year that the disease appears. If this is so, one ought to be able to cut out the disease, at least in some instances. Practically, the cells and vessels of the living parts of the tree are all closed cavities; *i. e.*, there are no capillary tubes large enough and at the same time long enough to easily permit the passage of micro-organisms from one part of the tree to another, if, indeed, there are any bacteria small enough to pass at all in this way without destruction of the tissues. On such a theory it must therefore take considerable time for a germ to penetrate to all parts of the tree, since there is no breaking down and decay of tissues such as occurs in pear blight and other plant diseases known to be due to bacteria. The only destruction of tissues I have observed was due to "gummosis." In the wood of diseased shoots I have found closed gum-cavities, due to the metamorphosis of fibers and vessels, but I do not yet know how constant a symptom this may be, or just what relation it may bear to the disease. Gummosis is known to occur in plums and cherries, which are not subject to yellows.¹

The almost universal statement of the books is that yellows can not be cut out of a tree, no matter how slightly affected. At first I was disposed to accept this statement as true beyond question; but having heard counter statements, and having seen in Delaware one perfectly

¹ See Frank, *Die Krankheiten der Pflanzen*, Breslau, 1880, p. 86, and Sorauer, *Handbuch der Pflanzenkrankheiten*, Berlin, 1886, 2d ed., Part I, p. 871. Consult also some notes on gummosis in the peach by Dr. J. C. Arthur, *Third Ann. Rep. N. Y. Agri. Exp. Station*, 1884, p. 375.

healthy tree from which the disease is said to have been removed three years ago by a severe excision, and having seen in another orchard some indication of recovery after similar excisions, I determined to repeat this experiment. Two trees were selected in orchard No. 12, eighteen in orchard No. 14, and three in the orchard from which Photo. X was taken, that tree, however, not being one of the three. The excisions were made in September, 1887, with the utmost care. The trees were all young and vigorous, and were only slightly diseased; *i. e.*, they bore premature peaches on one limb only, or on a few small branches, the rest of the tree bearing healthy peaches and full-grown dark-green foliage. In most cases the diseased limbs also bore spring foliage of normal size and color, and had not yet sent out many of the characteristic shoots; in some instances not any. In every case I removed not only the diseased branches, but also the large sound limbs which bore the affected parts, taking away from one-third to one-half the tree. These trees were previously selected with great care, as being those in which such an experiment was most likely to succeed. After the excisions each one was again carefully scrutinized in all parts, so that by no possibility should any portion be left which bore external manifestations of the disease. I did not use a disinfected saw, but the stumps were carefully painted with red lead, and this was rubbed in, especially in the vicinity of the cambium.

In August, 1888, these trees were re-examined. All of them bore premature peaches, and most of them also showed the diseased shoots. Moreover, they were so badly diseased—*i. e.*, bore the shoots or premature peaches on so many branches—that a new or secondary infection in 1888 seemed entirely out of the question. This also seemed improbable from the condition of other trees in the orchards (see Map IV). On the theory of a new infection in 1888, 100 per cent. of these trees became re-infected in one year, whereas in the orchards as a whole the new cases did not much exceed 10 per cent.

Fearing I might not have cut early enough in the season, I repeated this experiment in 1888, in August, in several orchards, particularly in orchard No. 6 (see Map II). This time my excisions were still more severe. Many large limbs, clothed with healthy foliage and bearing a great many sound peaches, were removed for the sake of getting rid of small diseased limbs and making assurance doubly sure. In most cases I removed from one-half to two-thirds of each tree, that part remaining, as well as a large per cent. of what was removed, appearing to be perfectly healthy. The results of these experiments will be awaited with interest. If they agree with those already detailed, it may be conceded as reasonably certain that the disease can not be cut out, and it may also be concluded that the trees are not infected through the blossoms, at least not the same year that the premature peaches appear.

Another way of testing the validity of this theory would be to remove all the blossom buds from healthy trees in infected orchards and note

the results for a series of years. This experiment ought to be undertaken in the spring of 1889 in several orchards and in a sufficient number of trees to give unequivocal results.

V. RESTRICTIVE LEGISLATION.

WHERE IT HAS BEEN TRIED.

Michigan.—The first yellows law ever enacted was by the legislature of Michigan, in 1875 (see Appendix B). This was in response to an urgent demand from all the peach-growers in the State, exclusive of those living in Berrien County. In this county at that time there were hundreds of badly diseased orchards, and the passage of a law meant the entire destruction of some of these. Naturally, the opposition to the passage of such a measure was extremely violent. There was great bitterness of feeling, and every effort was made to conceal the exact state of the orchards and to defeat the bill. Even Mr. Bidwell's carefully-prepared report on the condition of orchards in southwestern Michigan in 1873, which was the result of personal inspection and would be invaluable now, was suppressed, apparently lest it should give offense. The final result of this feeling was a compromise. A local act was passed making the law apply only to the three counties of Van Buren, Allegan, and Ottawa, in which the orchards were not yet seriously diseased. The orchards of Berrien County were not molested.

In 1879 this law was repealed, and one embracing the whole State took its place. There was then no opposition from Berrien County, but some hearty support, the destruction of the orchards by yellows being then nearly complete. This law of 1879 (as may be seen by consulting Appendix B) was a very cumbersome document, and proved difficult of execution. In fact, the delays and vexations incident to its enforcement rendered it practically inoperative, or would have done so but for a strong public sentiment in its favor. The framers of this law evidently had more consideration for the property rights of owners than for the safety of surrounding orchards. They were certainly not alive to the necessity of dealing promptly and thoroughly with a disease believed to be communicable. The benefit of the doubt was given to the owner, whereas it should have been given to the public.

So many were the defects of this law that in 1881 an entirely new and much more efficient law was placed on the statute book (see Appendix B). This law met with very general approval, and is still in force, although in most localities public sentiment is strong enough to secure the prompt eradication of diseased trees without recourse to the law. The most important provisions of this law are as follows: (1) It is unlawful to keep, sell, or ship trees or fruit when diseased by yellows; (2) both are public nuisances which may be destroyed in due form without liability for damage; (3) it is the owner's duty to destroy as soon as known; (4) when any member of the township board knows or believes

yellows is present, or is likely to be imported or to appear, it becomes the duty of the board to appoint three yellows commissioners; (5) these commissioners must file acceptance within ten days, and the township clerk must keep a formal record of their proceedings; (6) on suspicion, with or without complaint, one of the commissioners must examine all doubtful trees and fruit, and mark such as are found to be diseased; (7) the board of commissioners must then at once, personally or in writing, notify the owner or person in charge to destroy them; (8) if this is not done within ten days, the commissioners shall immediately destroy them in person, or by others, having right and power to enter upon all premises for this purpose; (9) persons ignoring such notice are guilty of a misdemeanor, and subject to fine or imprisonment, or both, in the discretion of the justice court; (10) all expenses of such removal are recoverable by the township from the owner.

The principal defects in this law are (1) that it does not make all the commissioners in the State responsible to some one executive head, whose sole business shall be to keep records, disseminate information, and see that the work is well done, and (2) that it does not pay them sufficient to make the strict enforcement of the law an important *personal* matter. As the law now stands it is enforced in some places and not in others, and no careful records are kept so as to determine the per cent. of trees annually destroyed. The law has been in force in Michigan long enough to have furnished the strongest kind of statistical evidence in its favor if such records had only been systematically preserved.

Ontario.—The first Ontario law was passed in 1831, being modeled after that of Michigan (see Appendix B). This law was amended in 1884, so as to be practically worthless, for the following reasons: (1) A petition of fifty rate-payers is necessary to secure the appointment of an inspector, if the council is not disposed to appoint without; (2) the inspector can act only on written complaint; (3) the fine for neglect to destroy trees and for sale or shipment of fruit is trifling; (4) no provision is made for the immediate and complete destruction of trees and fruit in case of neglect or refusal on part of owner to comply with the law.

New York.—The New York law was passed in 1887. It is almost identical with that now in force in Michigan (see Appendix B).

WHAT HAS BEEN ACCOMPLISHED.

Long before any laws were enacted many peach-growers had come to the conclusion that prompt removal and destruction was the only proper way to deal with yellows. As long ago as 1828 William Prince earnestly advised this course. Since that date Noyes Darling, Robert Sinclair, A. J. Downing, Charles Downing, J. J. Thomas, T. T. Lyon, Charles W. Garfield, and many other prominent writers on American pomology have also advocated prompt removal and destruction. The

opposition, with few exceptions, has been on the part of persons less competent to judge and has had its main root in pecuniary and private interest.

Naturally the first question to be asked is, Whether these laws have accomplished the desired result? Has the removal of these trees stopped the spread of the disease? If so, where? If not, why not? First, however, it may be well to inquire whether individual efforts in this direction have accomplished anything.

In the badly infected districts of Maryland and Delaware I could not see that removal of trees in 1887 or failure to remove them made much difference in 1888. In orchard No. 6 of this report (see Map II) 11 per cent. of the trees became diseased in 1887, and were removed that fall or early next spring, with the exception of a very few which were overlooked. In 1888, 11.4 per cent. of the remaining healthy trees became affected. In orchard No. 14 of this report (see Map IV) 9 per cent. of the trees became diseased in 1887 and were not removed. In 1888, 11.4 per cent. of the remaining healthy trees became diseased. These two orchards are of about the same size, age, and condition; are in districts about equally affected, became diseased the same year and to about the same extent, and are on similar soil. So far as I know, they may in all respects be taken for comparison.

However, on almost any theory of infection the removal of diseased trees can not be expected to yield very marked results when all the surrounding orchards are badly affected and the destruction of trees is entirely neglected. A fairer test was found in localities less affected. There, in a half dozen or more orchards, where the owners had removed diseased trees systematically for a series of years, *e. g.*, Nos. 4, 5, and 16 of this report, I thought I detected a tendency of the disease to spread more slowly than in neighboring orchards. Yet this may have been due to other causes than the removal of contagium.

Several persons have reported more convincing results. In 1843 A. J. Downing declares,¹ "It is absolutely necessary to *destroy all trees having the yellows*, in order to insure a sound condition in a young plantation yet healthy;" and in 1849 he states that by pursuing this course the disease had been almost entirely eradicated at Newburgh, N. Y.² In 1878 A. A. Olds, of Decatur, Mich., states that—

The orchards of Saint Joseph where no means were taken to check the disease were used up pretty thoroughly in four or five years. In others where radical measures of extermination were adopted the length of time was doubled.³

The prompt removal of 102 out of 3,300 four-years-old trees in 1876, in an orchard on the "Henry Walker Farm," in Thoroughfare Neck, on Smyrna Creek, near Flemming's Landing, Delaware, is said by Dr. Dunlap,⁴ on the authority of John Carrow, of Saint George's, to have

¹ *The Cultivator*, Albany, N. Y., 1843, p. 103.

² *The Horticulturist*, Albany, N. Y., 1849, p. 503.

³ *Ann. Rept. of the Sec. of the Mich. State Pom. Soc.*, 1878, p. 259.

⁴ Letter of September 5, 1887.

checked the spread of the disease at that time. In 1886 this orchard is said to have been in good bearing. Unfortunately I had no opportunity to verify these statements.

Michigan and Ontario are the localities where we must look for the most satisfactory answer to this inquiry. The first Michigan law took effect in 1875, and from that time to this, some yellows law has been in force. Fourteen years ought to be long enough to decide on the usefulness of such a measure.

I write the following paragraphs with considerable hesitation, not because I question the general accuracy of the statements, but because I have not made exhaustive studies in the orchards of southwestern Michigan, and shall have to depend almost entirely on the statements of other men—men, however, who are peach-growers, and for whose opinion I have much respect. The evidence that prompt destruction of all diseased trees checks the progress of the disease lacks scientific accuracy, but is nevertheless quite full and reasonably conclusive, as much so perhaps as circumstantial evidence and general impressions can ever be. My own belief is that the Michigan law is capable of accomplishing the desired result, and that it has accomplished it very satisfactorily in the places where it has been strictly enforced. I regret that I can not furnish something in the nature of exact proof. As it is, I can only give impressions and general statements of the growers.

Some of these are as follows :

(1) That dreadful scourge of the peach-grower, yellows, has made slow but marked progress during the year in this locality. The law has not been observed as closely as it should be in the matter of cutting and burning the trees at sight, nor yet in the shipping of partially diseased fruit. After all, a great majority of the leading fruit-growers fully believe that as a rule those who have cut out their trees at once as soon as discovered, have not only got the most trees left, but have for a term of years lost a much less percentage than those who have allowed their trees to stand through the season in order to pick what fruit they were able to obtain before cutting the tree down. A large majority also believe that the disease can be kept in check if all fruit-growers would dig out and burn all trees as soon as they discover the disease.—Secretary J. G. RAMSDELL, South Haven, Mich.¹

(2) We think we are holding the disease in check by promptly destroying the trees on the first manifestation of the disease.—JOSEPH LANNIN, South Haven, Mich.²

(3) By prompt measures the disease, which promised to sweep everything before it, has been stayed, and the hope is born that soon we shall be able to resist its further encroachments.

The advent of that paralyzing disease, the yellows, introduced a new epoch in Michigan peach culture. It swept the industry from Berrien County before its power was known, and invaded the counties northward; but a careful study of the habits of the disease and protective legislation have assisted the growers to meet the destroyer in successful combat. And although to-day little more is known of the cause of the disease than when it first invaded our soil, its symptoms are so well understood, and the most approved methods of warfare so thoroughly taught to growers, that its prog-

¹ *Ann. Rept. of the Sec'y of the Mich. State Hort. Soc., 1882*, p. 306.

² *Ibid., 1884*, p. 11.

ress is not feared.—Address on Michigan horticulture, by Hon. CHAS. W. GARFIELD, of Grand Rapids, Mich.¹

(4) We can control the disease perfectly among thrifty orchardists because they will dig out every infected tree as soon as the disease develops. The malady is not now spreading in our State.—CHARLES W. GARFIELD.²

(5) G. H. La Fleur, of Millgrove, Allegan County, writes that yellows first appeared in Casco Township in 1874, and gradually extended northward into Ganges and Saugatuck, and eastward into Allegan Township. He first saw the disease in the summer of 1876, *i. e.*, ten years after it was discovered at Saint Joseph. "By this time most growers became convinced that the ax and fire were the only remedies, hence the disease spread not so rapidly as in the southern part near the point of its origin." Mr. La Fleur also says that in the east part of Allegan County, where the law has not been enforced, the disease has reduced the number of trees 50 per cent. and greatly discouraged peach growing, while in the west part of the county, where the disease first appeared, but where the law has been enforced, the number of peach trees has increased annually.

Many instances have come under his observation where, by the prompt removal of the diseased trees, the yellows has been kept in check; and also where, with little or no attention paid to the removal of diseased trees, whole orchards soon became diseased and are now dead.³

(6) We have had yellows commissioners since 1879, and one year, 1885, I think, they kept an exact record showing the number of trees in every orchard examined and the number of trees diseased with yellows so as to give the percentage of loss. I have not the figures, but I have kept track of the matter closely enough to be certain that the disease has not increased in any orchard where the proper attention was given, *i. e.*, where the trees were destroyed as soon as they were known to be diseased. For instance, in Mr. Baxter's orchard were found more diseased trees the first year than were found there in any subsequent year. Mr. Halstead, in an orchard of say two thousand trees, destroyed more trees the first year that the disease appeared than he found in any year after that. He has an orchard that is seventeen or eighteen years old, and it has very many of the original trees still, and in a healthy, bearing condition. I have observed the matter carefully, and have found invariably that when great care was taken to destroy the diseased trees and to give proper cultivation, etc., those orchards have survived and given good results, and on the other hand, when the trees—diseased trees—were neglected, allowed to remain, the disease has invariably spread very rapidly and the entire orchard has soon disappeared.

* * * * *

I do not think that the loss from yellows [ever] amounts to more than say 5 per cent. a year, generally much less than that, frequently not above 1 per cent. of the trees in the orchard.—Hon. C. D. LAWTON, Lawton, Mich.⁴

(7) I was commissioner of yellows for this township (Saugatuck) for six years. When entering upon that work I attempted to make a list of diseased trees in every orchard and the varieties affected, but in a little time found that I could not carry out my plan. I could not go through all the orchards in our township, and examine every tree in the limited time in which such work must be done. As the larger part of our fruit-men are anxious to learn how to detect the existence of yellows in their orchards, it soon became evident that a little instruction would enable very many to take care of their own orchards. Then the commissioner would only find it necessary to look after the careless ones. In this way we have succeeded in doing a great deal of work at a small expense of time and money. All peach-growers who became

¹ *The Semi-Centennial of the Admission of the State of Michigan into the Union—Addresses.* Detroit Free Press Co., 1886, pp. 419, 420.

² Letter of August 3, 1887.

³ Letter of February 2, 1888.

⁴ Letter of January 24, 1888.

thoroughly aroused to the destructive nature of the yellows, have cut diseased trees without delay as soon as discovered. For several years after the disease made its appearance in this town some men refused to cut their trees, but of late nearly every one cuts diseased trees as soon as they are found. * * *

My neighbor had about three thousand trees. In the year 1878 I condemned three hundred trees in his orchards. He cut out all that he found with marks of disease, but failed to find them all. Since that year he has cut all condemned trees, and for the last five years not over twenty per year, although he has enlarged his orchards to six thousand trees. In my orchard of three hundred in 1877 one tree had the yellows; in 1878, forty trees had the yellows. These we cut and dug out. In 1879 we found six trees with yellows. Since that time I have enlarged my orchards from year to year, until they now contain about three thousand trees, from one to fifteen years of age, and no yellows have appeared since 1879. These cases are good illustrations of the whole township.

Every man within the range of my personal knowledge who has cut out all diseased trees without delay has not lost very heavily after the first year, while those who have delayed this work have continued to lose every year.—Rev. JAMES F. TAYLOR, Douglas, Mich.¹

(8) I have had no yellows in my orchards for the last six years. I think I have not lost in all to exceed ten trees.—L. HOWARD, Ganges, Mich.²

Mr. Howard adds that the neighboring Perrotet orchard, which was set in 1862 and removed in 1886, never suffered from yellows until 1885, when the commissioners condemned five or six trees. On his own farm he cut down peach trees thirty years old, not on account of yellows, but because they stood near an apple orchard and were crowded out.

(9) D. W. Wiley, of Douglas, a yellows commissioner for four years, has no doubt as to the efficacy of the law, but says: "In some of our lake-shore towns there seems to be a neglect in taking out and destroying diseased trees. In these localities the disease is on the increase, and from such neglect we may in time lose all our trees."³

(10) Harrison Hutchins states that in Allegan County yellows is less prevalent on the light sand within a mile or two of Lake Michigan than on the heavier and more fertile loams 5 or 6 miles distant, where the law has not been so well enforced.⁴

(11) The disease is in nearly all orchards, more or less, *i. e.*, trees show up every summer. Every grower expects to find some; but I think in very few very serious—the past four years from 1 to 20 trees in each. The past season [1888] has shown a slight increase over the several last, but not nearly as serious as from 1878 to 1882.

The yellows law at present practically enforces itself. I do not know of a grower in this township, and I think of but one in the adjoining one of Casco that does not fully believe the diseased trees must be taken out to save the balance of the orchard. I think a yellows commissioner has not been called for for the last four years; but before that it cost South Haven about \$100 per year for his services. It cost several growers a good many times that before they would believe thorough taking out the trees would save their healthy trees, one orchard of 2,500 being swept clean. But the thorough work of some growers resulted in all cases in saving a good part of the trees. The only cases where such was not the result were where growers were surrounded by those that would not remove the disease and so kept the vicinity seeded with the yellows. The result has been so conclusive that those who opposed the strongest the enforcement of the law are now in full accord with it, and, if still growing peaches, remove the disease as soon as it shows. There are many fine young orchards now growing on the same ground from which the disease swept the old trees. I have one myself—trees three years old—on land that the previous owner allowed to go with the yellows. So far, no disease has shown in the young trees.

¹ Letter of January 25, 1888.

² Letter of April 1, 1888.

³ Letter of April 18, 1888.

⁴ Letter of November 1, 1888.

I must say the disease is more prevalent where the law has been enforced, simply for the reason that there is still something for it to feed upon. To prove this, I will say that ten years ago the townships of Bangor, Arlington, and Geneva, in this county, especially the first two, were shipping thousands of baskets of peaches. They never enforced the law. I do not think there is a shipper in either of the three townships to-day, nor do I know of an orchard. Of course there is no yellows. I saw orchards there seven or eight years ago in which nearly every tree was affected.

As for South Haven and Casco, where the law has been enforced, and also in Antwerp, in the southeast part of this county, I think it is safe to say there are ten bearing trees to one twelve years ago, and that, too, notwithstanding the heavy losses we had for several years. I am fully convinced not a bearing, healthy tree would be here to-day, had it not been for our enforcement of the yellows law.

I do not know of any other statistics than those to which you refer (see p. 177). We have no need of them here. The results are enough for us. Probably the New Jersey growers can learn like our neighbors at Saint Joseph and Benton Harbor. The latter did not and would not believe the disease was contagious. Fifteen or eighteen years ago it took a half-dozen steamers to carry their peaches. To-day they have not a bearing orchard in the whole country. They have learned something, however. They have cleared the old trees out thoroughly and are starting again, and so far doing well.—A. G. GULLEY, South Haven, Mich.¹

The statements from Ontario are to much the same effect. D. W. Beadle, of St. Catharines, a prominent member of the Ontario Fruit Growers' Association, and formerly editor of *The Canadian Horticulturist*, writes as follows :

The peach yellows first appeared in Ontario about twelve years ago—almost simultaneously at Grimsby and Stamford. * * * In Stamford it has destroyed many of the orchards entirely. In Grimsby up to the present time its ravages have not been so severe. I can not say that it is any less prevalent now than it has been. The law has not been carefully enforced; it has been better enforced in the Grimsby section than in any other part of the Niagara district, and we are inclined to believe that it is owing to the attention paid to this law that the disease has been less destructive in Grimsby than in Stamford.²

Linus Woolverton, of Grimsby, secretary of the Fruit Growers' Association of Ontario, and present editor of *The Canadian Horticulturist*, writes as follows:³

The law concerning the destruction of peach trees affected with the yellows has been enforced, especially for two or three years while the disease was at its worst. The inspectors visited orchards affected, and marked the trees that should be destroyed, and in most instances the owners that knew the dangerous nature of the disease were only too glad to follow out orders and co-operate in the destruction of the affected trees.

I may say that the disease has been checked, because affected orchards have been almost completely cut down and burned; but still we find young orchards showing it here and there, especially [?] if planted where diseased trees have lately been removed, and as the inspectors have relaxed their exertions we may shortly be in as bad a state as ever.

Very much, however, depends upon the orchardists. I am of the opinion that more depends upon them than upon the inspectors, and a dissemination of the knowledge of the dangerous nature of the yellows and the necessity of prompt extermination of trees affected should accompany any legislation upon the subject.

¹ Letter of November 26, 1888.

³ Letter of February 24, 1888.

² Letter of June 1, 1888.

The only exact annual record I have been able to find of trees examined and trees destroyed is the following:

TABLE XIX.—*Showing result of examinations at South Haven, Mich.*

[By D. B. Williams, yellows commissioner.]

Year.	Number of trees examined.	Number with yellows.	Per cent. diseased.
1879..	62,856	2,245	3.5
1880..	68,758	5,675	8.0
1881..	71,353	3,256	4.5
1882..	120,425	4,544	4.0

This report covers only about two-thirds of the territory intended. Two other commissioners were appointed, but made no report. None have since been appointed, and no record has been kept.¹ Had this record been continued to date, and extended to include all trees at South Haven, it would now be invaluable.

WHAT MAY BE HOPED.

In discussing this question I shall assume that peach yellows is a communicable disease. The evidence in favor of such an assumption is stronger than that which has sufficed to hang many a man, and in the absence of direct proof to the contrary is certainly strong enough to warrant legislative action. In all such cases the public have a right to claim the benefit of the doubt. Even in the present inexact state of our knowledge it is justifiable on the part of State legislatures to make statutes compelling the immediate removal and destruction of all affected trees.

In peach-growing States now free from the disease it would be wise to prohibit the introduction of all trees from infected areas. Certainly, if yellows does not now occur in California (and by diligent inquiry I have failed to ascertain that it does), the greatest care should be taken to prevent its introduction, even to the extent of legislation strictly prohibiting the importation of peach trees from the Eastern United States. Unless such steps are taken the appearance of yellows in orchards on the Pacific coast is only a matter of time. To what a great extent California is interested in maintaining her present freedom from this disease may be known from the fact that in 1886 the peach orchards of that State contained 3,617,973 trees,² while the nectarine, almond, and apricot orchards contained about one-half as many more.

The principal objection to such laws is that valuable property will be destroyed. But it is sometimes necessary to destroy property for

¹ Postal of January 21, 1888.

² Official statistics by E. W. Maslin, secretary State Board of Equalization. *Biennial Report of the State Board of Horticulture for 1885 and 1886*. Sacramento, State office, 1887, pp. 515, 516.

the preservation of surrounding property, or for other reasons. Moreover, it may be urged against this objection (1) that premature peaches are of an inferior quality, generally unfit to eat, and are not eaten to any extent where they are grown, and ought not to be palmed off on an unsuspecting public to the possible injury of health and to the certain injury of markets and the discredit of good fruit; (2) that diseased trees speedily become unfruitful and worthless, and consequently have from the start only a small money value. Neither of these propositions can be disputed, and together they meet and fully answer this objection, which, moreover, is of small weight in comparison with the reasons assigned for action.

In my judgment the prompt destruction of affected trees by fire, if practiced throughout a community, will greatly hinder the progress of the disease. With the utmost care cases will appear from time to time, more some years than others, but there will be no outbreak comparable to an epidemic. At least such has been the experience in communities which have practiced this method from the first appearance of the disease. Whether a locality which has once suffered disastrously can again become a profitable region by the strict enforcement of this method remains to be seen. The results at Benton Harbor and Saint Joseph, Mich., where this is being tried, will be watched during the next few years with the greatest interest. According to R. Morrill, of Benton Harbor, 300,000 peach trees have been set in the vicinity of that place during the past three years, and no yellows have yet appeared.¹

It will not, however, be of much permanent benefit, I conceive, for one man or a few men to remove their trees while the rest of the community neglect to do so. In the union of all fruit-growers there is strength and safety. If this method of restriction is to be given a fair trial it must be supported by a strong public sentiment, backed by a suitable law.

Where it is not possible to make a law apply to an entire State, on account of sectional opposition, it might at first be made to apply only to the regions least affected, as in case of the Michigan law of 1875.

VI. CONCLUSIONS AS TO THE CAUSE OF YELLOWS.

HYPOTHESES RULED OUT.

From what precedes we are reasonably safe in concluding that yellows is not due to climatic influences. Frost, floods, and drouths may be modifying influences, but are nothing more. Injuries by men, quadrupeds, and borers may also be included in the list of disproved theories. They stand in no causal relation to this disease. To the same

¹ Report at meeting of West Michigan Fruit Growers' Association, December 18, 1888.—*Allegan Gazette*, January 12, 1889.

category may be added excessive cultivation, neglect of cultivation, and neglect of pruning. So also injury to tap-roots, propagation by buds rather than by seeds, defective drainage, use of animal manures, etc. Some of these things may favor the development of peach yellows, but I think none of them can cause it. The evidence here set forth seems to establish this beyond reasonable doubt. Probably most of my readers will be ready to admit that soil-exhaustion is also an unsatisfactory explanation. As the case now stands, this theory must be set aside as untenable. At least, we need give no further attention until more and stronger evidence is adduced in its favor. I write this with regret, for I hoped to be able to confirm this view, as it would have offered an easy and practical solution of the whole difficulty.

HYPOTHESES PROBABLY RULED OUT.

Among supposed causes deserving further inquiry I should place root-aphides and root-fungi. I am inclined to believe that neither one is at the bottom of the trouble; yet another summer in the field would enable me to speak more positively.

REMAINING PROBABLE HYPOTHESES.

What then remains? The larger fungi are out of the question, and I can think of nothing else but micro-organisms. The spread of yellows from diseased buds to healthy stocks, which I have carefully verified, points strongly to some *contagium virum* as the cause of the disease. If a micro-organism be really the cause, it probably occurs quite constantly in some part of each diseased tree, and this must be established beyond question; it must also be clearly distinguished from similar organisms not related to the disease; and, finally, it must be isolated by cultivation in suitable nutritive media and be able to produce the disease when inserted into healthy trees. If, from a pure culture of some micro-organism peach yellows can be induced in healthy trees, then the case is closed and there can be but one verdict. I write this paragraph with ease, but the work itself is full of difficulties. Nature does not yield her secrets upon the mere asking. Only those engaged in similar inquiries can have any adequate conception of the labor involved or of the perplexities which beset one at every step. Moreover, in such an inquiry nothing can be promised in advance. The investigator and the public alike must take their chances on the results. However, as I have elsewhere stated, there seems to be every encouragement for the renewed and persistent prosecution of this inquiry. By such effort sources of error will be discovered, difficulties overcome, and the truth finally established.

APPENDIX A.

CHEMICAL ANALYSES.

Some analyses of healthy and diseased peach tissues, made in this country and undertaken for the purpose of throwing some light on the nature of peach yellows, are presented herewith in full.

When necessary for comparison I have also introduced transformed tables giving the constituents in the form of acids and oxides. These equivalent tables follow those given by the chemists themselves.

ANALYSES BY PROFESSOR EMMONS, OF ALBANY, N. Y.¹

TABLE I. "Small seedling peach. Age of the tree, twenty-three years. Mean diameter, 3½ inches. Thickness of bark, one-seventh of an inch. Growth, rather slow. Average thickness of each [annual] layer, 0.0699 of inch."

Ash constituents.	Bark of trunk.	Wood of trunk.	Bark of root.	Wood of root.	Leaves.	Pits.*	Bark of limbs.†	Wood of limbs.†
Potash	1.20	7.11	3.16	8.58	12.41	18.47	8.85	19.21
Soda		11.15	1.92	15.92	.....	5.21	.....	8.11
Chloride of sodium	0.04	0.16	0.33	5.60	.....	2.70	0.28	0.24
Chloride of potassium					0.36	.....	.....	.....
Sulphuric acid	4.19	1.51	3.44	0.58	12.12	15.12	6.18	8.07
Carbonic acid ‡ .....					.....	.....	.....	.....
Lime	42.17	23.26	38.48	0.11	14.77	16.80	31.98	24.64
Magnesia	2.16	6.40	2.91	0.01	8.00	1.33	6.00	9.76
Phosphate peroxide of iron	0.45	0.32	10.40	1.02	2.47	1.33	1.60	0.60
Phosphate lime	18.79	29.19	10.40	18.10	10.44	17.98	8.50	13.20
Phosphate magnesia	0.01	1.34	.....	30.00	3.15	0.02	0.20	0.20
Organic matter	3.30	5.20	3.60	2.55	0.86	6.61	5.00	8.40
Insoluble silica	4.15	1.35	9.40	6.46	6.42	10.00	4.30	1.00
Coal			1.40	.....	4.48	.....	1.00	1.20
Total	109.04	104.97	104.56	89.02	86.85	128.77	99.03	104.99

*Analysis made with two grains of ash. †Peach limbs half an inch in diameter. ‡Not stated.

¹Report of the Commissioner of Patents. Part II. Agriculture, 1849, p. 479.

TABLE II. *Leaves taken July 22.*

Ash constituents.	Healthy.	Affected with the yellows.
Phosphates	9.60	11.60
Lime	16.22	14.30
Magnesia	5.90	5.30
Potash	14.28	14.44
Soda	21.22	22.28
Chlorine	5.12	4.74
Silicic acid	0.60	0.80
Sulphuric acid	4.42	4.43
Carbonic acid	13.30	13.20
Organic acids	7.90	4.30
Total	98.56	99.39

ANALYSIS BY B. KIRTLAND, POLAND, OHIO.¹

TABLE III.

Ash constituents.	Limbs and twigs of three varie- ties.*
Charcoal and sand	3.180
Silica	1.480
Perphosphate of iron	2.174
Potash	12.545
Soda	2.00
Sulphate of lime	2.258
Lime	23.951
Phosphate of lime	21.639
Magnesia	7.052
Peroxide of manganese .....	.800
Chloride of sodium .....	.699
Carbonic acid	33.350
Loss in analysis	3.812
Total	115.090

* Yellow Rarripe, Red Raripe, and Morissana. Healthy.

Equal quantities of limbs and twigs from the three kinds above named were taken and after having been thoroughly dried (whereby they lost about 44 per cent. of water) carefully burned with a moderate heat.

¹ *Elliott's Fruit Book*, by F. R. Elliott, of Pomona Gardens, near Cleveland, Ohio. New York. 1854, pp. 263, 264

When converted into acids and oxides for comparison, this analysis reduces to the following:

TABLE IV.

Ash constituents.	Limbs and twigs of three varie- ties.*
Charcoal and sand.....	3.18
Silica SiO_2	1.48
Oxide of iron, Fe_2O_3	1.15
Oxide of manganese, MnO_2	0.80
Lime, CaO	36.64
Magnesia, MgO	7.05
Potash, K_2O	12.55
Soda, Na_2O	2.33
Phosphoric acid, P_2O_5	10.96
Sulphuric acid, SO_3	1.33
Carbon dioxide, CO_2	33.35
Chlorine	0.37
Loss	3.81
Total	115.00

* Yellow Rarripe, Red Rarripe, and Morissana. Healthy.

ANALYSES BY DR. R. C. KEDZIE, AGRICULTURAL COLLEGE, MICHIGAN.¹

TABLE V.

Ash constituents.	Branches collected at Benton Harbor, Mich., in 1871.	
	Healthy.	Diseased by yellows.
Carbonate of potash	10.38	7.24
Carbonate of soda.....	3.12	3.82
Chloride of sodium.....	.13	.21
Sulphate of lime .....	.92	1.41
Carbonate of lime.....	62.10	66.61
Phosphate of lime	15.71	13.16
Carbonate of magnesia	5.31	5.05
Silicic acid.....	1.21	1.40
Oxide of iron.....	.92	.84
Moisture and loss.....	.30	.26
Total	100.00	100.00

¹ Annual Report of the Sec. of the Mich. State Pom. Society, 1871, p. 476.

When converted into acids and oxides for comparison with other analyses, Table V reduces to the following:

TABLE VI.

Ash constituents.	Branches collected at Benton Harbor, Mich., in 1871.	
	Healthy.	Diseased by yellows.
Silica, SiO_2	1.21	1.40
Oxide of iron, Fe_2O_3	0.92	0.84
Lime, CaO	43.67	45.02
Magnesia, MgO	2.53	2.40
Potash, K_2O	7.07	4.93
Soda, Na_2O	1.88	2.33
Phosphoric acid, P_2O_5	7.20	6.03
Sulphuric acid, SO_3	0.54	0.83
Carbon dioxide, CO_2	34.71	35.85
Chlorine	0.07	0.11
Moisture and loss.....	.30	0.26
Total	100.00	100.00

ANALYSES BY CHARLES A. GOESSMANN, PH. D., PROFESSOR OF CHEMISTRY IN THE MASSACHUSETTS AGRICULTURAL COLLEGE, AMHERST.¹

TABLE VII.

Ash constituents.	Fruit— Crawford's Early peach, healthy.	Fruit— Crawford's Early peach, diseased.
	Per cent.	Per cent.
Ferric oxide, Fe_2O_3.....	.58	.46
Calcium oxide, CaO	2.64	4.68
Magnesium oxide, MgO ...	6.29	5.49
Phosphoric acid, P_2O_5	16.02	18.07
Potassium oxide, K_2O	74.46	71.30
Total.....	100.00	100.00

TABLE VIII.

Ash constituents.	Branch— Crawford's Early peach, restored.	Branch— Crawford's Early peach, diseased.
	Per cent.	Per cent.
Ferric oxide.....	.52	1.45
Calcium oxide.....	54.52	64.23
Magnesium oxide.....	7.58	10.28
Phosphoric acid.....	11.37	8.37
Potassium oxide	26.01	15.67
Total.....	100.00	100.00

¹ *Trans. of the Mass. Hort. Society*, 1882, Part I, p. 122.

ANALYSES OF THE ASH OF HEALTHY AND DISEASED PEACH WOOD BY THE CONNECTICUT EXPERIMENT STATION, DR. S. W. JOHNSON, DIRECTOR. E. H. JENKINS, PH. D., VICE-DIRECTOR.¹

TABLE IX.

Ash constituents.	Twigs of Mountain Rose peach, growth of one year.* Collected by P. M. Augur.	
	I. Healthy.	II. Diseased by yellows.
Silica and matters insoluble in acid.....	5.38	9.47
Oxide of iron	1.09	2.09
Lime	54.20	54.05
Magnesia	9.49	7.49
Potash.....	16.31	13.95
Soda.....	1.18	1.19
Phosphoric acid.....	4.34	4.68
Sulphuric acid.....	6.90	6.53
Chlorine.....	.46	.43
Total	99.35	99.88

* They were about five-sixteenths of an inch in diameter at the butt end and three-sixteenths to four-sixteenths of an inch in diameter at tip.

A more correct comparison is that of the absolute quantities of the several ash-ingredients contained in the same amount of fresh twigs, as follows:²

TABLE X.

Ash constituents.	Parts in 10,000 of—	
	Healthy twigs.	Diseased twigs.
Silica and insoluble.....	10.07	15.25
Oxide of iron	2.04	3.36
Lime	101.44	86.99
Magnesia	17.75	12.05
Potash.....	30.55	22.45
Soda	2.20	1.91
Phosphoric acid	8.14	7.53
Sulphuric acid.....	12.91	10.51
Chlorine.....	.87	.70
Total parts of ash	185.97	160.75

¹ Annual Report of the Connecticut Agricultural Experiment Station, 1884, p. 93.

² *Ibid.*, p. 94.

ANALYSIS BY LEWIS MURBACH, STATE UNIVERSITY, ANN ARBOR, MICH.

This analysis was made at my request, by an advanced student of chemistry, under the direction of Dr. Albert H. Prescott.

The samples for analysis were stocky shoots of one year's growth, gathered April 4, 1888, from eight-year-old trees in the orchard of Michael O'Toole, Ann Arbor, Mich., on a side hill northeast of the observatory. The soil is clay loam, containing stones, and in places stony. The orchard contained about two hundred trees. The trunks were black, rough, and unsightly, having suffered considerably from severe winters, but the trees appeared healthy and were all perfectly free from yellows, as are all the trees in that locality. They bore a good crop of peaches in 1887. I took the shoots from twelve trees of three varieties, Crawford's Late, Hill's Chili, and Old Mixon, selecting the best I could find. They came from the main limbs and trunk, chiefly the former, and were a well matured, thrifty, and remarkably fine-looking lot, the bark toward the extremities being very smooth and red. They varied in length from 24 to 69 inches and in diameter at the base from one-fourth to one half an inch. The majority were about 4 feet in length, with a diameter of one-third of an inch at base. The larger shoots bore a number of branches which were also well matured. The season was not far advanced and the buds had not begun to push. After cutting into short lengths the branches were turned over to the chemist with the following results:

	Per cent.
Weight of green twigs.....	100.00
Weight of twigs after drying at 115° C	55.00
Loss of H ₂ O.....	45.00
Weight of dry wood.....	100.00
Weight of ash (including CO ₂)	3.13
Weight of volatile products.....	96.87

TABLE XI. *Ash constituents.*

Ash constituents.	Parts in 100.
Silica, SiO ₂ , etc	4.01
Oxide of iron, Fe ₂ O ₃ .....	.71
Lime, CaO	47.42
Magnesia, MgO	2.92
Potash, K ₂ O*	15.72
Phosphoric acid, P ₂ O ₅	15.34
Sulphuric acid, SO ₃	2.73
Carbon dioxide, CO ₂	15.30
Chlorine .....	.33
Total	97.26

* Includes Na₂O. The Na₂O was estimated at 1.91 but owing to the difficulty of completely separating the two alkalies, whereby some of the potash may have been included with the soda, it was thought best to reckon it all as potash.

† A second determination gave 5.11.

Excluding CO₂ and refiguring, we get:

TABLE XII.

Ash constituents.	Parts in 100.
Silica, SiO ₂ , and other insoluble matter.....	5.43
Oxide of iron, Fe ₂ O ₃ .....	.96
Lime, CaO	54.57
Magnesia, MgO.....	3.94
Potash, K ₂ *	21.22
Phosphoric acid, P ₂ O ₅	7.21
Sulphuric acid, SO ₃	3.69
Chlorine .....	.45
Total	97.22

* Includes Na₂O.

ANALYSES BY A. E. KNORR, ASSISTANT CHEMIST, U. S. DEPARTMENT OF AGRICULTURE.

These analyses were made in the chemical laboratory of the Department of Agriculture principally from material collected in Maryland and Delaware in 1887. The most important determinations were carried through in duplicate, and ample time was given in which to secure exact results. Unfortunately, in case of the wood and twigs the fresh and dry weight were not ascertained, and by an accident the ash of the healthy Delaware peaches was lost before the analysis was completed. Soils were also collected, but no analyses have been made.

TABLE XIII.—*Analysis of a section of the trunk of a badly-diseased tree of Crawford's Early, from orchard of F. H. Harper, Still Pond, Md., No. 6 of this report. Collected August 8, 1887. Trunk diameter, 4½ inches; age, seven years.*

Ash constituents.	First determina- tion.	Second determina- tion.	Mean.
Unburnt carbon .....	.32	.....	.32
Silica, SiO ₂	4.99	.....	4.99
Oxide of iron, Fe ₂ O ₃ .....	.65	.....	.65
Lime, CaO	44.44	44.57	44.51
Magnesia, MgO	5.24	5.43	5.34
Potash, K ₂ O	10.56	10.30	10.43
Soda, Na ₂ O	2.71	2.75	2.73
Phosphoric acid, P ₂ O ₅	6.15	6.18	6.17
Sulphuric acid, SO ₃ .....	.77	.76	.77
Chlorine	Trace	Trace	Trace
Carbon dioxide, CO ₂	23.63	23.73	23.68
Total .....	.....	.....	99.60

Excluding CO_2 and refiguring, we get:

TABLE XIV.

Ash constituents.	Mean.
Unburnt carbon .....	.42
Silica, SiO_2	6.55
Oxide of iron, Fe_2O_3.....	.85
Lime, CaO	58.39
Magnesia, MgO	7.01
Potash, K_2O	13.69
Soda, Na_2O	3.58
Phosphoric acid, P_2O_5	8.10
Sulphuric acid, SO_3	1.01
Chlorine	Trace.
Total.....	99.60

The height of this tree was about 12 feet. It presented a very peculiar appearance. Every branch and almost every twig was diseased, but there were no dead limbs and almost no dead twigs, which was evidence of recent attack. The tree was full of foliage, most of which was dwarfed and lighter green than that of the trees around it. From all parts of this tree—trunk, branches, sub branches, and twigs—grew out hundreds (no exaggeration) of short pale-green shoots 1 to 6 inches long, bearing many pale-green, linear leaves, which were only 1 to 3 inches long by one-fourth to three-fourths inch broad.¹ A few of the diseased shoots were longer, 1 to 2 feet, and branched. This tree bore only one peach, a dwarfish, overripe premature. At this date in that orchard none of the healthy Crawford's Early bore ripe peaches. The bark on the trunk and limbs was sound, and the collar was 6 inches in diameter. There were no injuries by borers, and had never been any, the bark on the collar being entirely sound, except two recent small bruises made by a hoe. Very careful excavation under and around the stump revealed no dead roots or root injuries, but some of the rootlets were dead. Soil, clay-loam (8 inches); subsoil, yellow clay.

¹ Healthy full-grown leaves are 6 to 9 inches long by $1\frac{1}{2}$ to 2 inches broad.

TABLE XV.—*Analysis of a section of the trunk of a badly diseased tree of Old Mixon, from orchard of F. H. Harper, Still Pond, Md.—No. 6 of this report. Collected August 10, 1887. Trunk diameter, 5½ inches; age, seven years.*

Ash constituents.	First determination.	Second determination.	Mean.
Unburnt carbon .....	.26	.....	.26
Silica, SiO_2	4.18	.....	4.18
Oxide of iron, Fe_2O_3.....	.69	.....	.69
Lime, CaO	41.99	42.16	42.08
Magnesia, MgO	4.23	4.42	4.33
Potash, K_2O	13.44	13.60	13.52
Soda, Na_2O	2.40	1.55	1.98
Phosphoric acid, P_2O_5	6.55	6.67	6.63
Sulphuric acid, SO_3	1.08	1.23	1.16
Chlorine	Trace.	Trace.	Trace.
Carbon dioxide, CO_2	24.59	24.84	24.72
Total .....	.....	.....	99.55

Excluding CO_2 and refiguring, we get—

TABLE XVI.

Ash constituents.	Mean.
Unburnt carbon .....	.35
Silica, SiO_2	5.56
Oxide of iron, Fe_2O_3.....	.92
Lime, CaO	55.98
Magnesia, MgO	5.76
Potash, K_2O	17.99
Soda, Na_2O	2.63
Phosphoric acid, P_2O_5	8.82
Sulphuric acid, SO_3	1.54
Chlorine	Trace.
Total	99.55

The height of this tree was about 14 feet; the top was well developed and symmetrical. The trunk was 2 feet long, dividing into four main branches. The bark on the trunk and branches was smooth and perfectly sound. There were no dead branches and scarcely any dead twigs. The spring shoots were well developed and stocky, all the leaves being full grown and fine looking. Many of these shoots, *i. e.*, those from the winter buds, were 1 to 2 feet long, and, so far as I could observe, none of them showed any starved leaves or diseased shoots; but from every one of the four main limbs I took quite a good many large, ripe, high-colored peaches. On the east branch (the one least diseased) were fifteen or twenty healthy, green, half-grown peaches, but even on this limb some of the smaller branches bore a few shoots of the starved sort, clothed with pale-green, dwarfed leaves. There were no tufted

growths on the tree, but it bore in all nearly or quite one hundred small, pale-green shoots, the leaves on which were less than one fourth their proper length and proportionately narrow. These unbranched twigs had grown out singly all over the tree, except on the trunk, the extreme base of the lower limbs, and the terminal shoots of the season. There were none on these parts. In 1886 the tree hung full of fruit, none of which was premature (so said). After making notes on the parts above ground, the tree was dug out and the collar, roots, and rootlets carefully examined; but I could find no injury by borers, no dead bark, no dead wood, no fungus. The collar was 7 inches in diameter and perfectly sound. The abundant roots were examined outward several feet in all directions. Soil, clay-loam (8 inches); subsoil, yellow clay.

This tree was seven rows in from the north and sixteen in from the east (see Map II). With the exception of three trees in the same row (first two north and second one south), the trees in the immediate vicinity were healthy and looked well. Owing to clean cultivation, weeds were not abundant, but I saw in the vicinity *Plantago major*, L., *Asclepias Cornuti*, Decaisne, *Euphorbia hypericifolia*, L., and plenty of *Panicum sanguinale*, L., but no *Polygonums*. The tree had suffered no mechanical injury, and there appeared to be nothing whatever in the surroundings to account satisfactorily for its condition.

TABLE XVII.—*Analysis of a section of the trunk of a badly diseased tree of Crawford's Early, from orchard of C. H. Price, Still Pond, Md.—No. 2 of this report. Collected August 16, 1887. Trunk diameter, 4 $\frac{3}{4}$ inches; age, seven years.*

Ash constituents.	First determina- tion.	Second determina- tion.	Mean.
Unburnt carbon .....	.28	.....	.28
Silica, SiO_2	3.39	.....	3.39
Oxide of iron, Fe_2O_3 .....	.56	.....	.56
Lime, CaO	43.76	43.94	43.85
Magnesia, MgO	3.04	2.80	2.92
Potash, K_2O	10.29	10.94	10.17
Soda, Na_2O	1.91	1.87	1.89
Phosphoric acid, P_2O_5	5.02	4.99	5.01
Sulphuric acid, SO_3 .....	.65	.63	.64
Chlorine	Trace.	Trace.	Trace.
Carbon dioxide, CO_2	31.20	31.02	31.11
Total .....	.....	.....	99.82

Excluding CO₂ and refiguring, we get—

TABLE XVIII.

Ash constituents.	Mean.
Unburnt carbon .....	.41
Silica, SiO ₂	4.92
Oxide of iron, Fe ₂ O ₃ .....	.81
Lime, CaO	63.70
Magnesia, MgO	4.24
Potash, K ₂ O	14.77
Soda, Na ₂ O	2.75
Phosphoric acid, P ₂ O ₅	7.28
Sulphuric acid, SO ₃ .....	.93
Chlorine	Trace.
Total	99.81

The height of this tree was about 12 feet, and its spread of branches was about 15 feet. This tree looked very sick, but was not worse than many others in the same orchard. Diseased shoots to the number of several hundred grew from all parts of the tree, except the trunk and the base of the lower limbs. These pale shoots varied in length from 1 to 2 inches to 1 to 2 feet, the longer ones being considerably branched, but not tufted. Scarcely a branch on the tree was free from these shoots, and on several limbs they grew out numerously, erect, along the whole length, giving to the limb a very peculiar appearance, such as one might expect to see if a tree had been entirely defoliated. Most of these shoots grew from obscure buds in June, July, or August. None of them were stocky, like healthy "water-shoots." The leaves they bore were small, narrow, and unhealthy, being light green or pale, as if etiolated. Many of these leaves were exceeding small, and none were full size or healthy color. The spring shoots, *i. e.*, those from the winter buds, had made an excellent growth of 1 to 2 feet, and bore full-grown dark green leaves, except a few in the center of the tree. Even the bases of these terminal branches were beginning to develop weak etiolated shoots one-half an inch to 2 inches long from their leaf axils. With the exception of some quite small branches and a few short twigs in the interior, there were no dead branches in any part of the tree. The fruit prematurely in 1887, but was gone at the date of my examination, except two or three peaches which were undersize, overripe, and nearly tasteless. Mr. Price said the tree would die next season. I was inclined to think this the second year of attack, but was not certain. The bark on the trunk and limbs was smooth and perfectly sound. The diameter of the collar was 6 inches. It had been injured by borers, but not seriously. Farther down, and well underground, borers had worked narrow passages under the bark on the upper side of four roots, aggregating a total bark destruction of as much as 7 square inches, but not seriously affecting any one root. Except on one root, the wood under these injuries was sound. In this root, a narrow strip one-quarter to one-half an inch wide by one-quarter of an inch

deep and 4 inches long was dry-rotted, the rot extending up to and for a short distance into the collar, there being a slightly darker ring between the sap and heart wood on that side. This root was 2 to 3 inches in diameter and otherwise sound, as were all the other roots branching from it, and the collar itself. From this tree there grew fourteen main roots, varying in diameter from 1 to 3 inches, and all perfectly sound, except as before mentioned. After removing the trunk section I pulled the bark from the collar and main roots, but found no other injuries. The bark and cambium seemed normal, but some of the rootlets were dry and dead. This tree stood on level ground on the north side of the orchard. Soil, loose sandy loam (8 to 10 inches); subsoil, a coarse yellow sand, with only a slight admixture of clay. The soil is not muddy after the heaviest rains. The subsoil compacts and retains shape in the fingers, but falls apart easily.

TABLE XIX. *Analysis of a section of the trunk of a badly-diseased tree of *Christiana* from orchard of Dr. W. S. Maxwell, Still Pond, Md.—No. 1 of this report. Collected August 17, 1887. Trunk diameter, 4½ inches; age, five years.*

Ash constituents	First determina- tion.	Second determina- tion.	Mean.
Unburnt carbon .....	.21 .....		.21
Silica, SiO_2	3.49		3.49
Oxide of iron, Fe_2O_3 .....	.69 |	.67 |	.68
Lime, CaO	42.31 |	42.14 |	42.23
Magnesia, MgO	4.51 |	4.20 |	4.36
Potash, K_2O	11.20 |	10.91 |	11.06
Soda, Na_2O	1.63 |	1.54 |	1.59
Phosphoric acid, P_2O_5	6.43 |	6.30 |	6.37
Sulphuric acid, SO_3 .....	.56 .....		.56
Chlorine	Trace. |	Trace. |	Trace.
Carbon dioxide, CO_2	30.24 |	30.00 |	30.12
Total			100.67

Excluding CO_2 and refiguring we get:

TABLE XX.

Ash constituents.	Mean.
Unburnt carbon .....	.30
Silica, SiO_2	4.97
Oxide of iron, Fe_2O_3 .....	.97
Lime, CaO	60.26
Magnesia, MgO	6.22
Potash, K_2O	15.78
Soda, Na_2O	2.27
Phosphoric acid, P_2O_5	9.09
Sulphuric acid, SO_3 .....	.80
Chlorine	Trace.
Total	100.66

The height of this tree was about 12 feet, the well-developed top being composed of three main branches of nearly equal size. On this tree

many of the terminal shoots were 2 feet long, stocky, and supplied with full-grown, good, green leaves; but on the bases and lower and middle parts of the limbs (where ordinarily are no tender growths) were several hundred pale-green shoots of recent appearance; these were 1 to 8 inches or more in length, were mostly unbranched, and grew out singly here and there; they bore small, pale-green leaves more or less inclined to roll inward (upward). There were no dead branches and very few dead twigs, and the tree could not have been diseased prior to 1886. The tree bore two peaches, one an overripe premature and the other a hard, dwarfed, woolly fruit. Many peaches started to grow, but rotted or dried up during the summer. The trunk was smooth and sound. On one limb were two slight abrasions, from which gum exuded; the other limbs were perfectly sound. After the tree was dug out I scraped the outer bark from the collar and main roots; the bark on both was bright looking and entirely sound, except for a few slight injuries by borers. On one side of the lower cut of the section between the third and fifth annual rings, was a narrow discolored band—the wood was not dozy, and yet not perfectly sound. On splitting open the stump in several directions the discolorations were found to pass out of the tree as seams between the main roots directly under the crown, *i. e.*, the incipient decay did not extend into the roots. For location of this tree, which was not more badly diseased than many others in the same orchard, see Map I. Soil, mellow clay-loam (8 inches); subsoil, yellow clay.

TABLE XXI.—*Analysis of three bundles of yearling shoots from trees of Crawford's Late in orchard of James W. Green, Magnolia, Del.—No. 14 of this report. Collected September 5, 1887.*

Ash constituents.	Shoots which grew in 1887.									
	I. Healthy shoots.			II. Apparently healthy, but from diseased trees.			III. Badly diseased.			Mean.
	First deter- mi- nation.	Second deter- mi- nation.	Mean.	First deter- mi- nation.	Second deter- mi- nation.	Mean.	First deter- mi- nation.	Second deter- mi- nation.		
	—	—	—	—	—	—	—	—	—	—
Unburnt carbon .....	.19	—	.19	.32	—	.32	.24	—	—	.24
Silica, Si O_2 .....	.71	—	.71	1.04	—	1.04	1.49	—	—	1.49
Oxide of iron, Fe_2O_3 ..	.23	—	.23	.52	—	.52	.44	—	—	.44
Lime, CaO	40.66	40.49	40.58	38.50	38.55	38.53	23.90	23.85	23.88	
Magnesia, MgO	4.74	4.87	4.81	5.70	5.73	5.72	6.04	5.80	5.97	
Potash, K_2O	15.67	15.37	15.52	17.28	17.55	17.42	31.92	31.80	31.86	
Soda, Na_2O} .....	.60	.44	.57	.79	1.17	.98	1.39	.93	1.16	
Phosphoric acid, P_2O_5 ..	7.61	7.48	7.55	7.50	7.53	7.52	13.86	13.72	13.79	
Sulphuric acid, SO_3 ..	1.09	.93	1.01	1.36	1.38	1.37	.96	.94	.95	
Chlorine	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	
Carbon dioxide	28.62	28.48	28.55	26.86	26.92	26.89	20.94	20.84	20.89	
Total	—	—	99.72	—	—	100.31	—	—	—	100.67

Excluding CO₂ and refiguring, we get:

TABLE XXII.

Ash constituents.	Shoots which grew in 1887.		
	I. Healthy shoots,	II. Apparently healthy but from diseased trees.	III. Badly dis- eased.
		Mean.	Mean.
Unburnt carbon .....	.27	.44	.30
Silica, SiO ₂	1.00	1.42	1.88
Oxide of iron, Fe ₂ O ₃ .....	.32	.71	.56
Lime, CaO	56.86	52.63	30.13
Magnesia, MgO	6.74	7.81	7.53
Potash, K ₂ O	21.75	23.80	40.20
Soda, Na ₂ O .....	.80	1.35	1.46
Phosphoric acid, P ₂ O ₅	10.58	10.27	17.40
Sulphuric acid, SO ₃	1.41	1.87	1.19
Chlorine	Trace.	Trace.	Trace.
Total	99.73	100.30	100.65

These shoots were all from robust trees on the south side of orchard No. 14 of this report (see Map IV).

Lot I consisted of a bundle of yearling shoots cut from five perfectly healthy trees. There were diseased trees on the same soil in the vicinity, but the nearest trees were healthy. These shoots grew from the base of the main limbs. The length varied from 2 to 5 feet, and the diameter at the butt from one-half of an inch to somewhat less than one-fourth of an inch. All bore large dark green, healthy leaves, and were very stocky, vigorous shoots.

Lot II consisted of a bundle of yearling shoots cut from six diseased trees, five of the six being the trees which furnished Lot III. They much resembled Lot I, but were less robust. These apparently healthy shoots from diseased trees were unbranched and bore full-grown leaves of healthy color, but came from trees bearing numerous rampant yellows-growths and not infrequently from near points on branches bearing such starved, wiry, sprangly, branched shoots; some of them grew side by side with yellows-shoots, *i. e.*, out of the same branch and within an inch or two of the latter; others came from the trunk, above the collar, or from limbs which did not yet appear to be diseased.

Lot III consisted of a bundle of badly diseased yearling shoots cut from six trees affected by yellows. These sprouts were 2 to 4 feet long; slenderer than those in Lots I and II, and much branched, many of the branches being very long and willowy. The foliage was pale green or yellowish, not red. It was very abundant and very depauperate; there

were hundreds of narrow leaves, not over 1 to 2 inches long. At the ends of many shoots, where the lateral budshad sent out short branches, the foliage had a tufted appearance.

The foliage of each lot was removed or became dry and fell away before the analyses were made.

TABLE XXIII. DETERMINATION OF THE QUANTITY OF ASH IN FOUR SAMPLES OF PEACHES.

I.—*Premature Beers' Smock from old orchard of W. R. Morris, Dover, Del. Collected September 3, 1887.*

	Per cent.
Fresh substance.....	100.00
Dry substance.....	12.65
Ash.....	.45

II.—*Healthy ripe Beers' Smock from orchard of James W. Green, Magnolia, Del., No. 14 of this report. Collected September 17, 1887.**

	Per cent.
Fresh substance.....	100.00
Dry substance.....	15.19
Ash.....	.50

* The only compounds determined before loss of the ash were phosphoric acid and sulphuric acid, two determinations of each were made, the means being: P_2O_5 —13.46; SO_3 —0.72.

III.—*Healthy Bilyeu's October from New Castle, Cal., taken from a fruit stand in Washington, D. C., December 19, 1888.*

	Per cent.
Fresh substance.....	100.00
Dry substance (110° C.).....	18.90
Ash (excluding unburnt carbon).....	.71

IV.—*Healthy Bilyeu's October from California. Taken from a fruit stand in Washington, D. C., December 19, 1888; fruit shriveled somewhat and beginning to rot.*

	Percent.
Fresh substance.....	100.00
Dry substance (110° C.).....	21.24
Ash (excluding unburnt carbon).....	.84

TABLE XXIV. *Analysis of premature Beers' Smock peaches, from orchard of W. R. Morris, Dover, Del. Collected September 3, 1887.*

Ash constituents.	Diseased peaches.		
	First determina- tion.	Second determina- tion.	Mean.
Unburnt carbon .....	.42	.....	.42
Silica, SiO_2	4.14	.....	4.14
Oxide of iron, Fe_2O_3	Trace.	Trace.	Trace.
Manganese	Trace.	Trace.	Trace.
Lime, CaO	2.90	.....	2.99
Magnesia, MgO	3.22	.....	3.22
Potash, K_2O	56.51	57.00	56.75
Soda, Na_2O	3.36	3.58	3.47
Phosphoric acid, P_2O_5	14.14	14.16	14.15
Sulphuric acid, SO_3	1.24	1.29	1.27
Chlorine	Trace.	Trace.	Trace.
Carbon dioxide, CO_2	13.69	13.94	13.82
Total .....	.....	.....	100.23

Excluding CO_2 and refiguring we get:

TABLE XXV.—*Diseased peaches.*

Ash constituents.	Mean.
Unburnt carbon .....	.49
Silica, SiO_2	4.80
Oxide of iron, Fe_2O_3	Trace.
Manganese	Trace.
Lime, CaO	3.47
Magnesia, MgO	3.73
Potash, K_2O	65.83
Soda, Na_2O	4.02
Phosphoric acid, P_2O_5	16.41
Sulphuric acid, SO_3	1.47
Chlorine	Trace.
Total	100.22

TABLE XXVI.—*Ash analysis of the California peaches, Lots III and IV of Table XXIII.*

Ash constituents.	First determina- tion.	Second determina- tion.	Mean.
Unburnt carbon	24.97	.....	24.97
Silica, SiO_2	2.46	.....	2.46
Oxide of iron, Fe_2O_3	Trace.	.....	Trace.
Manganese	Trace.	.....	Trace.
Lime, CaO	1.58	1.53	1.56
Magnesia, MgO	2.23	2.25	2.24
Potash, K_2O	43.19	.....	43.19
Soda, Na_2O	3.04	3.56	3.30
Phosphoric acid, P_2O_5	8.79	8.94	8.87
Sulphuric acid, SO_3	1.73	.....	1.73
Chlorine	Trace.	.....	Trace.
Carbon dioxide, CO_2	11.35	11.48	11.42
Total .....	.....	.....	99.74

Excluding CO_2 , and in this case unburnt carbon on account of the very large amount present, and refiguring, we get:

TABLE XXVII.

Ash constituents.	Mean.
Silica, SiO_2	3.87
Oxide of iron, Fe_2O_3	Trace.
Manganese	Trace.
Lime, CaO	2.46
Magnesia, MgO	3.53
Potash, K_2O	68.00
Soda, Na_2O	5.20
Phosphoric acid, P_2O_5	13.97
Sulphuric acid, SO_3	2.72
Chlorine	Trace.
Total	99.75

APPENDIX B.

LEGAL ENACTMENTS.

The first law ever enacted for the restriction of yellows was as follows:

THE MICHIGAN YELLOWS LAW OF 1875.¹

AN ACT to prevent the spread of the contagious disease of the peach tree known as the yellows in the counties of Allegan, Van Buren, and Ottawa, and to provide measures for the eradication of the same.

SECTION 1. *The People of the State of Michigan enact*, That any and all trees in the counties of Allegan, Van Buren, and Ottawa, whether peach, almond, apricot, or nectarine, infected with the contagious disease known as the yellows, shall be held to be without pecuniary value and the fruit unfit for use as food; and that, as the best known means of preventing the spread of such disease, both tree and fruit so infected shall be subject to destruction as public nuisances.

SEC. 2. In any township of the counties of Allegan, Van Buren, and Ottawa in which the contagious disease of the peach, almond, apricot, or nectarine tree, known as the yellows, is believed to exist or in which danger may be apprehended of its spread or introduction, it shall be competent for any five or more residents of the same or of an adjoining township to make allegation of such belief or apprehension in writing, addressed to the township board of such township, and requesting them to take measures, as hereinafter provided, to prevent the spread of such contagious disease and for the eradication of the same, which request must be filed by the clerk of the township in which such application is made.

SEC. 3. It shall be the duty of the township clerk, on the receipt of the request specified in section 2 of this act, to call a meeting of the township board within ten days thereafter, and upon the assembling of said board to lay such allegation and request before them; whereupon it shall be the duty of said board to appoint a discreet and suitable person as commissioner, who shall hold his office during the pleasure of said board, and to said commissioner shall be submitted any and all complaints of the existence or impending introduction of said contagious disease, arising under the provisions of this act within such township.

SEC. 4. Complaints of the existence or impending introduction of said disease may be made by any one or more residents of the same or of any adjoining township, and must be in writing, addressed to said commissioner, and must state distinctly the premises on which such disease is alleged to exist, or the name and residence of the owner, and the place of distribution, shipment, or exposure for sale of the fruit alleged to be so infected.

SEC. 5. It shall be the duty of such commissioner, on the receipt of any such complaint, to proceed without unnecessary delay to the examination of the alleged case or cases; and if he shall become satisfied of the actual existence of the yellows in standing trees, he shall affix a distinguishing mark to each tree so affected, and im-

¹ *Local acts, Michigan, session of 1875.* Lansing: W. S. George & Co., printers, No. 379, p. 726.

mediately notify the owner or occupant of the premises on which such trees shall be standing, in person, or by leaving a written notification at his usual place of residence, requiring him, within five days from the date of such notice, to uproot and effectually destroy, by fire or otherwise, the trees so designated; and in the case of affected fruit introduced into the township, or distributed, shipped, or offered for sale therein, he shall in the same manner notify the owner or person in charge thereof to withhold the same from distribution, shipment, or sale, and to destroy the same within the above-named period of five days from such notice.

SEC. 6. In case the trees decided to be so infected shall be upon non-resident lands it shall be the duty of the commissioner to give the required notice, by posting a copy of the same at some conspicuous place upon said non-resident premises, and by serving a copy of the same upon any resident of the township or vicinity who may be in charge of such premises, and by directing a copy of such notice by mail to the owner of said premises, if his name and residence shall be known.

SEC. 7. Whenever the person or persons who shall have been served with the notice or notices provided in sections 5 and 6 of this act shall refuse or neglect to comply with the requirements of the same within the period therein prescribed, it shall be the duty of said commissioners to immediately enter upon the premises and effectually uproot and destroy such affected or diseased trees or fruits.

SEC. 8.—Any owner or occupant of premises on which such condemned trees or fruit shall be, who shall consider himself aggrieved by the decision of the commissioner, may, within three days from the date of the notice served upon him, by a written notification, inform said commissioner of his purpose to contest the decision as to the diseased or infected character of such trees or fruit; whereupon it shall be the duty of such commissioner forthwith to notify the members of the township board to assemble on the premises on which such trees or fruit shall be, on the day on which the aforesaid notice requiring the destruction of such diseased trees will expire, then and there to examine the trees or fruit in question, and to hear such evidence as shall be presented bearing upon the question at issue; and if said township board, or a majority thereof, shall, after a proper hearing of the case, decide that said trees are so diseased or affected, they shall direct said commissioner, without unnecessary delay, to uproot and destroy the trees in question, or to destroy the fruit, as the case may be, unless the owner or occupant shall forthwith proceed to do so.

SEC. 9. In any case in which an owner or occupant of premises, or a person in charge thereof, shall be notified by a commissioner of the diseased or infectious character of any trees or fruit thereon, whether grown thereon or imported, and in which such owner, occupant, or person in charge shall refuse or neglect, in compliance with such notice, after its confirmation by the township board, to destroy such trees or fruit, the expenses of the commissioner in effecting such destruction, including the cost of the assembling of the township board and of the evidence necessarily produced in the case, shall be a charge, *firstly*, upon the defendant in the case; or, *secondly*, upon the premises upon which such trees or fruit shall be grown.

SEC. 10. Any owner, occupant, or person in charge of premises or fruit who shall refuse or neglect to comply with the order of the commissioner for the destruction of diseased or affected trees or fruit, upon the confirmation of such order by the township board, as provided in this act, shall be liable to a fine, to be imposed at the discretion of such township board, not exceeding one hundred dollars with costs, to include those of the commissioner and of the township board; the same to be certified to the supervisor of the township, and by him collected in an action of assumpsit, before any justice of the peace having jurisdiction of the case; or, upon the order of the board, to be included in the next annual tax list, and collected as a tax upon the premises upon which such trees or fruit shall be grown.

SEC. 11. The proceeds of all fines accruing under the provisions of this act shall be paid into the treasury of the township, to the credit of the general fund; and the commissioner and the members of the township board shall, for services rendered

under the provisions of this act, be allowed the same rate per diem that is by law allowed for ordinary sessions of said board, which shall be paid from said general fund.

SEC. 12. This act shall take immediate effect.

Approved May 1, 1875.

This act was in force four years. It was superseded by the act of 1879.

THE MICHIGAN YELLOWS LAW OF 1879.¹

AN ACT to prevent the spread of the yellows, a contagious disease among peach, nectarine, and other trees, and to extirpate the same, and to repeal the local act 379 of the session laws of 1875, approved May 1, 1875.

SECTION 1. *The people of the State of Michigan enact*, That it shall be unlawful for any person to keep any peach, nectarine, or other trees infected with the contagious disease known as the yellows, or to offer for sale or shipment, or to sell or ship to others, any of the fruit thereof; and no damage shall be awarded in any court of this State for the destruction of such diseased trees and fruit, as hereinafter provided; and it shall be the duty of every citizen as soon as he becomes aware of the existence of such disease in any tree or fruit owned by him, to forthwith destroy or cause the same to be destroyed.

SEC. 2. In any township in this State in which such contagious disease exists, or in which there is good reason to believe it exists, or danger may be justly apprehended of its introduction and spread, it shall be lawful for any five or more resident freeholders of the same or of any adjoining township to set forth such fact, belief, or apprehension in a petition addressed to the board of such township, requesting them to appoint three commissioners, as hereinafter provided, to prevent the spread or introduction of such disease, and to eradicate the same, which petition shall be filed with and become a part of the records of the township to which such application is made.

SEC. 3. It shall be the duty of the township clerk, on receipt of the petition specified in section 2 of this act, to call a meeting of the township board within ten days thereafter, and upon the assembling of said board to lay such petition before them, whereupon it shall be the duty of said board, upon the hearing of said petition, to appoint three competent resident freeholders of such township as commissioners, who shall hold their office during the pleasure of said board, and such order of appointment and revocation, when revoked, shall be entered at large upon the records of the township.

SEC. 4. It shall be the duty of said commissioners, within ten days after appointment as aforesaid, to file their acceptance of the same with the clerk of said township, and said clerk shall be *ex officio* clerk of said board of commissioners, and he shall keep a correct record of the proceedings of said board in a book to be provided for the purpose, and shall file and preserve all papers pertaining to the duties of said commissioners, or either of them, which shall be a part of the records of said township.

SEC. 5. Any one or more residents of the same or adjoining township may make complaint on writing and on oath, addressed to said commissioners, delivering the same to either of them, setting forth that said disease exists, or that he has good reason to believe it exists, upon lands within the township in which said commissioners reside, designating the same with reasonable certainty, or that trees or fruit infected with such disease are offered for sale or shipment, or have been introduced therein, designating the person in whose possession or under whose control such trees or fruit are believed to be.

¹ *Public Acts, Michigan, session of 1879.* Lansing: W. S. George & Co., printers. No. 32, p. 27.

SEC. 6. It shall be the duty of the commissioner to whom such complaint is delivered to proceed without unnecessary delay to examine the trees or fruit so designated, and if he shall become satisfied that the contagious disease actually infects such trees or fruit he shall, without injuring the same, fix a distinguishing mark upon each of the trees so infected, and immediately notify the person to whom such trees belong, personally or by leaving a written notice at his usual place of residence, if he be a resident of the county, and if such owner be a non-resident of such county, then by leaving the same with the person in possession of such trees, requiring him, within fifteen days, Sundays excepted, from the date of the service of said notice, to effectually remove and destroy, by fire or other means, the trees so marked, and in case of fruit so infected such notice shall require the person in whose possession or control it is found to immediately destroy the same or cause it to be done.

SEC. 7. If any person neglects to destroy, or cause to be destroyed, such diseased fruit, after such examination and notification, but sells, ships, or disposes of the same to others, such person shall be deemed guilty of a misdemeanor, and punished by a fine not exceeding a hundred dollars, or by imprisonment in the county jail not exceeding three months, or both, in the discretion of the court; and any justice of the peace in the township where such fruit is sold, shipped, or disposed of, as aforesaid, shall have jurisdiction thereof.

SEC. 8. Whenever any person shall refuse or neglect to comply with the notice to remove and destroy the trees marked by the commissioner as aforesaid, it shall be the duty of said commissioner forthwith to notify the other commissioners to assemble with himself on the premises on which said trees shall be, on the fifteenth day, Sundays excepted, after he shall have made service of such notice, and then and there personally to examine the trees in question, and the evidence bearing on the existence of said disease; and if said commissioners, or a majority of them, shall, after a proper examination of the matter, decide that said trees are infected with said disease, they shall, in case such trees so infected do not exceed six in number, order the same to be removed and destroyed forthwith, or cause it to be done, employing all necessary aid for that purpose, if the person in charge thereof refuses or neglects to do so; and in case the trees found to be infected shall exceed six in number, and the owner thereof shall, upon the serving of said notice, refuse or neglect to remove the same in accordance with the provisions of the act and terms of such notice, then and in that case the said commissioners shall petition the circuit court of the county for an order directing and empowering said commissioners to remove or cause to be removed such infected trees, and the courts shall direct the defendant to be summoned and an issue joined therein, and the cause to be tried in a summary manner, and if it shall appear on said trial that said trees are so infected, he shall grant the order prayed for, with costs of prosecution against the owner of such trees; but in case such trees are found not to be infected, he shall dismiss said proceeding, with costs to be taxed against the township in which such commissioners reside.

SEC. 9. Every person who shall wilfully refuse or neglect to comply with the notice of the commissioners, as hereinbefore provided, to remove and destroy said diseased trees, shall be liable for all the costs, charges, and disbursements made upon the proceedings of said commissioners and of the board of commissioners to effect such removal and destruction, together with a penalty of five dollars for each and every day, but not exceeding one hundred dollars in all, such trees remain undestroyed, which costs, charges, disbursements, and penalty shall be recovered of him in an action of trespass upon the case, in the form of assumpsit, brought and prosecuted by the supervisor, in the name and for the benefit of the township, and before any justice of peace therein in the same manner and with like proceedings as are applicable in civil cases before such courts, and upon judgment being rendered in favor of said township, the said justice of the peace shall issue execution against the defendant in said action—which may be stayed, as in other cases, but when collected, he shall pay the amount thereof forthwith to the treasurer of said township to the credit of the general fund.

SEC. 10. The form of the declaration in any suit instituted as aforesaid may be as follows, to wit: In justice court before A B, justice of _____ township, county _____, the township of _____, said county, complains of C D in an action of trespass upon the case, and says that C D justly owes the said township _____ dollars, being the amount of expenses incurred by said township in the removal and destruction of trees infected with the yellows, from designating the premises with reasonable certainty, and the penalty incurred by said C D for not removing and destroying said trees pursuant to an act entitled "An act to prevent the spread of yellows, a contagious disease among peach, nectarine, and other trees, and to extirpate the same," wherefore the said township brings suit.

A B, *Supervisor.*

SEC. 11. The commissioners shall be allowed for their services under this act \$2 for each full day, and \$1 for each half day, and their other charges and disbursements, hereunder to be audited, as well as any other charges and disbursements under this act, by the township board.

SEC. 12. In all suits and prosecutions under any of the provisions of this act it shall be necessary to prove that such trees or fruit were diseased or infected.

SEC. 13. [Repeals act 379 of local laws of 1875.]

SEC. 14. This act shall take immediate effect.

Approved April 4, 1879.

This law was in force two years, being superseded by the present law, which is as follows:

YELLOWS LAW OF 1881.¹

AN ACT to prevent the spread of the yellows, a contagious disease among peach, almond, apricot, and nectarine trees, and to provide measures for the eradication of the same, and to repeal act 32 of the session laws of 1879.

SECTION 1. *The people of the State of Michigan enact.* That it shall be unlawful for any person to keep any peach, almond, apricot, or nectarine tree infected with the contagious disease known as the yellows, or to offer for sale or shipment, or to sell or ship to others any of the fruit thereof; that both tree and fruit so infected shall be subject to destruction as public nuisances, as hereinafter provided, and no damages shall be awarded in any court in this State for entering upon the premises and destroying such diseased trees and fruit, if done in accordance with the provisions of this act; and it shall be the duty of every person, as soon as he becomes aware of the existence of such disease in any tree or fruit owned by him, to forthwith destroy or cause the same to be destroyed.

SEC. 2. In any township in this State in which such contagious disease exists, or in which there is good reason to believe it exists, or danger may be justly apprehended of its introduction, as soon as such information becomes known to the township board or any member thereof, it shall be the duty of said board to appoint forthwith three competent freeholders of said township as commissioners, who shall hold office during the pleasure of said board, and the order of appointment and revocation shall be entered at large upon the township records.

SEC. 3. It shall be the duty of said commissioners, within ten days after appointment as aforesaid, to file their acceptance of the same with the clerk of said township, and said clerk shall be *ex officio* clerk of said board of commissioners, and he shall keep a correct record of the proceedings of said board in a book to be provided for the purpose, and shall file and preserve all papers pertaining to the duties and actions of said commissioners, or either of them, which shall be a part of the records of said township.

¹ *Public acts, Michigan, session of 1881.* Lansing: W. S. George & Co., State printers. No. 174, p. 219. See also *Hastell's Annotated Statutes, Michigan, 1882*, Vol. I, chapter 66, p. 587.

SEC. 4. It shall be the duty of the commissioners, or any of them, upon or without complaint, whenever it comes to their notice that the disease known as yellows exists or is supposed to exist within the limits of their township, to proceed without delay to examine the trees or fruit supposed to be infected, and if the disease is found to exist, a distinguishing mark shall be placed upon the diseased trees and the owner notified, personally or by written notice left at his usual place of residence, or, if the owner be a non-resident, by leaving the notice with the person in charge of the trees or fruit, or the person in whose possession said trees or fruit may be. The notice shall contain a simple statement of the facts as found to exist, with an order to effectually remove and destroy, by fire or otherwise, the trees so marked and designated within ten days, Sundays excepted, from the date of the service of the notice; and in case of fruit so infected, such notice shall require the person in whose possession or control it is found to immediately destroy the same or cause it to be done. Such notice and order to be signed by the full board of commissioners.

SEC. 5. Whenever any person shall refuse or neglect to comply with the order to remove and destroy the trees marked by the commissioners, as aforesaid, it shall become the duty of the commissioners to cause said trees to be removed and destroyed forthwith, employing all necessary aid for that purpose, the expense for such removal and destruction of trees to be a charge against the township; and for the purpose of said removal and destruction the said commissioners, their agents and workmen, shall have the right and power to enter upon any and all premises within their township.

SEC. 6. If any person neglects to remove and destroy, or cause to be removed and destroyed, as aforesaid, such diseased trees or fruit, after such examination and notification, and within the time hereinbefore specified, such persons shall be deemed guilty of a misdemeanor, and punished by a fine not exceeding one hundred dollars, or by imprisonment in the county jail not exceeding three months or both, in the discretion of the court, and any justice of the peace of the township where such fruit is sold, shipped, or disposed of, as aforesaid, shall have jurisdiction thereof.

SEC. 7. The commissioners shall be allowed for services, under this act, two dollars for each full day and one dollar for each half day, and their other charges and disbursements hereunder to be audited, as well as any other charges and disbursements under this act, by the township board, all of which costs, charges, expenses, and disbursements may be recovered by the township from the owner of said diseased fruit, or from the owner of the premises on which said diseased trees stood, in an action of assumpsit.

SEC. 8. [Repeals act 32 of 1879.]

Approved May 31, 1881.

In 1881, the legislative assembly of the province of Ontario passed the following yellows law:¹

FIRST ONTARIO LAW.

AN ACT to prevent the spread of yellows among peach, nectarine, and other trees.

(Assented to 4th March, 1881.)

Her Majesty, by and with the advice and consent of the legislative assembly of the province of Ontario, enacts as follows:

1. It shall not be lawful for any person to keep any peach, nectarine, or other trees infected with the contagious disease known as the yellows, or to offer for sale or shipment, or to sell or ship any of the fruit thereof; and it shall be the duty of every person, so soon as he becomes aware of the existence of the said disease in any trees or fruit owned by him, to burn the same forthwith.

¹ *Statutes of the province of Ontario, Canada, 44th Victoria, 1881.* Toronto, Ont. Printed by John Notman. 1881, chapter 28, p. 283.

2. When the said disease exists, or there is good reason to believe it exists, or when there is good reason to apprehend its introduction, any five or more free-holders residing in the same or an adjoining municipality may petition the council thereof to appoint an inspector to prevent the spread or introduction of the said disease.

3. On receipt of such petition it shall be the duty of the clerk of the municipality to call a meeting of the council within ten days thereafter for the consideration of the same, and it shall be the duty of the said council, if satisfied of the truth of the facts stated in the petition, to appoint an inspector for the purpose of carrying out the provisions of this act and to provide for his remuneration.

4. It shall be the duty of the inspector to examine the peach and nectarine orchards of the municipality once between the middle and end of July and once between the middle and end of August every year, and he shall keep a correct record of the condition of each orchard and of the time spent in the performance of his duty, which time shall not exceed six days during each period of inspection, and shall, after each such inspection, file the said record with the clerk of the municipality.

5. In case written complaint is made to the inspector that the said disease exists, or that there is good reason to believe it exists, within the municipality in any locality described in such complaint with reasonable certainty, or that infected trees or fruit are offered for sale or shipment, or have been imported into the municipality by any person named, such inspector shall, without unnecessary delay, proceed to examine the trees or fruit so designated.

6. The inspector, if satisfied that the disease has actually infected any tree or fruit, shall affix a distinguishing mark upon each tree so infected, and shall immediately give notice in writing to the owner or occupier of the land whereon the said infected trees are growing, requiring him, within seven days from the receipt of said notice, to burn the trees so marked as hereinbefore directed; and in case of fruit so infected, such notice shall require the person in whose possession it is found to immediately destroy the same.

7. In case any owner or occupier refuses or neglects to destroy such diseased trees or fruit after such examination and notification he shall, upon conviction, be liable to a fine of not less than five dollars nor more than twenty dollars, for every such offense.

8. Every offense against the provisions of this act shall be punished, and the penalty imposed for each offense shall be recovered and levied, on summary conviction, before any justice of the peace, and all fines collected shall be paid as follows: One-half to the person laying the information or complaint, and the residue to the treasurer of the municipality in which the offense is committed, for the use of the municipality.

This act was repealed in 1884, the following taking its place:¹

SECOND ONTARIO LAW.

AN ACT to prevent the spread of noxious weeds and of diseases affecting fruit trees.

(Assented to 25th March, 1884.)

1. [This section repeals former acts.]

2. It shall be the duty of every owner of land, or the occupier thereof, if the owner is not resident within the local municipality wherein the same is situated, (1) to cut down or destroy all the Canada thistles, ox-eye daisies, wild oats, rag-weed, and burdock growing on his land to which this act may be extended by by-law of the municipality, so often each and every year as is sufficient to prevent the ripening of their seed; (2) to cut out and burn all the black-knot found on plum or cherry trees on his land, so often each and every year as it shall appear on such trees; and (3) to cut down and burn any peach, nectarine, or other trees on his land infected with the disease known as the yellows, and to destroy all the fruit of trees so infected.

¹ *Statutes of Ontario, Canada, 47th Victoria, 1884, chapter 37, p. 119.* Toronto, Printed by John Notman.

3. The council of any city, town, township, or incorporated village, may by by-laws extend the operation of this act to any other weed or weeds, or to any other disease of fruit trees or fruit which they declare to be noxious to husbandry or gardening in the municipality; and all the provisions of this act shall apply to such noxious weeds and diseases as if the same were herein enumerated.

Any such council may, and upon a petition of fifty or more ratepayers shall, appoint at least one inspector to enforce the provisions of this act in the municipality, and fix the amount of remuneration, fees, or charge he is to receive for the performance of his duties; and in case a vacancy shall occur in the office of inspector, it shall be the duty of the council to fill the same forthwith.

[Paragraph 3 provides that the council of any township may exempt waste or unoccupied lands.]

[Sections 4, 5, 6, 7, and 8 relate entirely to weeds.]

9. If written complaint be made to the inspector that yellows or black-knot exist within the municipality, or in any locality described in such complaint with reasonable certainty, he shall proceed to examine the fruit-trees in such locality, and if satisfied of the presence of either disease he shall immediately give notice in writing to the owner or occupant of the land whereon the affected trees are growing, requiring him within five days from the receipt of said notice to deal with such trees in the manner provided by section 2 of this act.

10. Any owner or occupant of land who refuses or neglects to cut down or destroy any of the said noxious weeds, after notice given by the inspector, as provided by section 4, or who knowingly suffers any of the said noxious weeds to grow thereon and the seed to ripen so as to cause or endanger the spread thereof, or who suffers any black-knot to remain on plum or cherry trees, or keeps any peach, nectarine or other trees infected with yellows or the fruit of trees so infected, shall upon conviction be liable to a fine of not less than five or more than twenty dollars for every such offense.

[Paragraph 2 relates to weeds.]

Any person who knowingly offers for sale or shipment, or sells or ships the fruit of trees infected with yellows shall, upon conviction, be liable to a fine of not less than five nor more than twenty dollars.

Every inspector, overseer of highways, or other officer, who neglects to discharge the duties imposed on him by this act shall, upon conviction, be liable to a fine of not less than ten nor more than twenty dollars.

11. Every offense against the provisions of this act shall be punished and the penalty imposed for each offense shall be recovered and levied, on summary conviction, before any justice of the peace; and all fines imposed shall be paid to the treasurer of the municipality in which the offence is committed, for the use of the municipality.

12. The council of every municipality in Ontario shall require its inspector, overseer of highways, and other officers to faithfully discharge all their duties under this act.

13. [This section relates to weeds.]

The State of California in 1885 enacted the following law, which by a somewhat free interpretation of the term "disinfection," might perhaps be made to apply to yellows should there be any occasion, and by a very slight amendment, or perhaps without any change, could certainly be used to prevent the introduction of nursery-stock from infected districts.¹

¹ *Statutes and amendments to the Codes, California. Extra session, 1884-'85. Sacramento, 1885.* James J. Ayers, superintendent State printing.

THE CALIFORNIA FRUIT LAW.

AN ACT to prevent the spreading of fruit and fruit-tree pests and diseases, and to provide for their extirpation.

Approved March 9, 1885.

The people of the State of California, represented in Senate and assembly, do enact as follows:

SECTION 1. It shall be the duty of every owner, possessor, or occupier of an orchard, nursery, or land where fruit-trees are grown within this State, to disinfect all fruit-trees grown on such lands infested with any insect or insects, or the germs thereof, or infested by any contagious disease known to be injurious to fruit or fruit-trees, before the removal of the same from such premises for sale, gift, distribution, or transportation. Fruit-boxes which have been used for shipping fruit to any destination are hereby required to be disinfected previous to their being again used for any purpose; all boxes returned to any orchard, store-room, sales-room, or any place used or to be used for storage, shipping, or any other purpose, must be disinfected within three days after their return; and any and all persons failing to comply with the requirements of this section shall be guilty of a misdemeanor. All packages, known as free packages, must be destroyed or disinfected before being again used.

SEC. 2. It shall be the duty of the owner, lessee, or occupier of any orchard within this State, to gather all fruit infested by the insects known as the codlin moth, peach moth, red spider, plum weevil, and kindred noxious insects, their larvae or pupæ, which has fallen from the tree or trees, as often as once a week, and dispose of or destroy the same in such a manner as to effectually destroy all such insects, their larvae or pupæ. It shall be the duty of the inspector of fruit pests,¹ or quarantine guardian, to inspect fruit packages, and all trees and plants, cuttings, grafts, and scions, known or believed to be infested by any insect or insects, or the germs thereof, or their eggs, larvae or pupæ, injurious to fruit or fruit-trees, or infected with any disease liable to spread contagion, imported or brought into this State from any foreign country, or from any of the United States or Territories, and if, upon inspection, such fruit, or fruit packages, are found to be infected or infested, it shall be a misdemeanor to offer the same for sale, gift, distribution, or transportation, unless they shall be first disinfected.

SEC. 3. Every person shipping fruit-trees, scions, cuttings, or plants, from any orchard, nursery, or other place where they were grown or produced, shall place upon or securely attach to each box, package, or parcel containing such fruit-trees, scions, cuttings, or plants, a distinct mark or label, showing the name of the owner or shipper, and the locality where produced. And any person who shall cause to be shipped, transported, or removed from any locality declared by the State board of horticulture to be infested with fruit-tree or orchard pests, or infected with contagious diseases injurious to trees, plants, or fruits, unless the same shall have been previously disinfected, shall be guilty of a misdemeanor. Disinfection shall be to the satisfaction of the State board of horticulture, or the inspector of fruit pests. When disinfected, the fact shall be stamped upon each box, package, or separate parcel of fruit-trees, scions, cuttings, or plants; and any person who shall cause to be shipped, transported, or removed, any such box, parcel, or package from a quarantine district or locality, not bearing such stamp, shall be guilty of a misdemeanor, and may be punished by fine, as provided in section six of this act. Any person who shall falsely cause such stamp to be used, or shall imitate or counterfeit any stamp or device used for such purpose shall be guilty of a misdemeanor.

SEC. 4. It shall be the special duty of each member of the State board of horticulture to see that the provisions of this act are carried out within his respective horticultural district, and all offenders duly punished.

¹ This inspector receives a compensation of \$200 per month and his traveling expenses, which must not exceed \$1,000 annually.

SEC. 5. All fruit-trees infested by any insect or insects, their germs, larvae or pupæ, or infected by disease known to be injurious to fruit or fruit-trees, and liable to spread contagion, must be cleaned or disinfected before the first day of April, eighteen hundred and eighty-five, and on or before the first day of April of each succeeding year thereafter. All owners or occupants of lands on which fruit-trees are grown failing to comply with the provisions of this section shall be guilty of a misdemeanor and fined as provided for in section six of this act. All fruit, packages, trees, plants, cuttings, grafts, and scions that shall not be disinfected within twenty-four hours after notice by the inspector of fruit pests, or a duly appointed quarantine guardian, or any member of the board of horticulture, shall be liable to be proceeded against as a public nuisance.

SEC. 6. Any person or corporation violating any of the provisions of this act shall be guilty of a misdemeanor, and shall, on conviction thereof, be punishable by a fine of not less than twenty-five dollars nor more than one hundred dollars for every offence.

The yellows law of New York, passed at the last session of the State legislature, is as follows:¹

LAW OF NEW YORK.

AN ACT to prevent the spread of the disease in peach trees known as the yellows.

[Passed May 19, 1887.]

The people of the State of New York, represented in senate and assembly, do enact as follows:

SECTION 1. It shall be unlawful for any one to knowingly or willfully keep any peach, almond, apricot, or nectarine tree infected with the contagious disease known as the yellows, or to offer for sale or shipment, or to sell or ship to others, any of the fruit thereof; that both tree and fruit so infected shall be subject to destruction as public nuisances, as hereinafter provided, and no damages shall be awarded in any court in this State for entering upon premises and destroying such diseased trees and fruit, if done in accordance with the provisions of this act; and it shall be the duty of every person, as soon as he becomes aware of the existence of such disease in any tree or fruit owned by him, to forthwith destroy or cause the same to be destroyed.

SEC. 2. In any town of this State in which such contagious disease exists, or in which there is good reason to believe it exists, or danger may be justly apprehended of its introduction, as soon as such information becomes known to the supervisor thereof, it shall be the duty of said supervisor to appoint forthwith three competent freeholders of said town as commissioners, who shall hold office during the pleasure of said supervisor, and such order of appointment and of revocation shall be entered at large upon the town records.

SEC. 3. It shall be the duty of said commissioners, within ten days after appointment as aforesaid, to file their acceptance of the same with the clerk of said town, and said clerk shall be *ex-officio* clerk of said board of commissioners, and he shall keep a correct record of the proceedings of said board in a book to be provided for the purpose, and shall file and preserve all papers pertaining to the duties and actions of said commissioners, or either of them, which shall be a part of the records of said town.

SEC. 4. It shall be the duty of the commissioners, or any one of them, upon or without complaint, whenever it comes to their notice that the disease known as yellows exists or is supposed to exist within the limits of their town, to proceed without delay to examine the trees or fruit supposed to be infected, and if the disease is found

¹ *Laws of New York, 110th session, 1887.* Albany, N. Y.: Banks & Brothers, publishers, 1887. Chapter 403, p. 504.

to exist, a distinguishing mark shall be placed upon the diseased trees and the owner notified personally, or by a written notice left at his usual place of residence, or, if the owner be a non-resident, by leaving the notice with the person in charge of the trees or fruit, or the person in whose possession said trees or fruit may be. The notice shall contain a simple statement of the facts as found to exist, with an order to effectually remove and destroy, by fire or otherwise, the trees so marked and designated, within ten days, Sundays excepted, from the date of the service of the notice; and in case of fruit so infected such notice shall require the person in whose possession or control it is found to immediately destroy the same or cause it to be done. Said notice and order to be signed by the full board of commissioners.

SEC. 5. Whenever any person shall refuse or neglect to comply with the order to remove and destroy the trees marked by the commissioners, as aforesaid, it shall become the duty of the commissioners to cause said trees to be removed and destroyed forthwith, employing all necessary aid for that purpose, the expense of such removal and destruction of trees to be a charge against the town; and for the purpose of removal and destruction the said commissioners, their agents and workmen, shall have the right and power to enter upon any and all premises within their town.

SEC. 6. If any owner neglects to remove and destroy, or cause to be removed and destroyed, as aforesaid, such diseased trees and fruit after such examination and notification, and within the time hereinafter specified, such person shall be deemed guilty of a misdemeanor, and punished by a fine not exceeding one hundred dollars, or by imprisonment in the county jail not exceeding three months, or both, in the discretion of the court; and any justice of the peace of the town where such fruit is sold, shipped, or disposed of, as aforesaid, shall have jurisdiction thereof, and all such fines so collected shall be turned over to the supervisor of the town, to be placed by him in the contingent fund of said town.

SEC. 7. The commissioners shall be allowed for services, under this act, two dollars for each full day and one dollar for each half day, and other reasonable charges and disbursements, hereunder to be audited, as well as any other charges and disbursements under this act, by the board of town auditors, to be paid to said commissioners as other town accounts are paid. Such fees and all reasonable charges and disbursements of said commissioners, in each case, may be recovered by the town, in the name of the supervisor, from the owner of the diseased fruit or trees on account of which such fees, charges, and disbursements became payable or were incurred.

SEC. 8. This act shall take effect immediately.

EXPLANATION OF PLATES.

ENGRAVINGS FROM PHOTOGRAPHS.

I. Diseased shoot from main limb. This should have remained unbranched, but under the influence of yellows it branched repeatedly, the much ramified apex of one branch being cut away. Nearly all buds on the main axis and most on the secondary axes germinated in autumn.

McDaniel orchard, Dover, Del. (No. 17 of this report), September 27, 1887. About one-fifth natural size.

II. Terminal shoots badly diseased, many branches cut away from the interior to give a clearer view. Strictly comparable with No. XIV, such shoots almost always remaining *entirely* unbranched in healthy trees.

McDaniel orchard, Dover, Del., September 27, 1887. About one-eighth natural size.

III. Yellows tuft from main limb of a moribund tree—all the growth of one season.

Orchard of E. P. Selmser, Dover, Del., September 3, 1887. Photographed November 5, from dried specimen. One-third natural size.

IV. Diseased terminal shoots from a tree which had been cut down.

South Haven, Mich., May 1, 1888. Strictly comparable with No. II, and with Fig. 4 of No. XXXVII, colored. About one-half natural size.

V. Peach tree suffering from yellows. The shoots of the season are branched considerably and many terminal buds have pushed, forming rosettes.

Tree stood in lawn on west side of Thirteenth street, near Boundary, Washington, D. C., Nov. 2, 1887. Nearly all the leaves of the normal or spring growth had fallen.

VI. Diseased tree; set six months. Roots badly infested by aphides, but growth of top not clearly distinguishable from yellows shoots. One-eleventh natural size.

Orchard of William R. Morris, Dover, Del., September 28, 1887.

VII. Healthy trees; set five months. Strictly comparable with No. VI.

Orchard of R. M. Richardson, Rising Sun, Del., August 27, 1888. About one-eleventh natural size, *i. e.*, tree was 63 inches high.

VIII. Tree on south side of orchard No. 14 of this report (see Map IV). Second year of the disease; tree barren; foliage much dwarfed; base of limbs grown up with diseased shoots. The foliage on the right edge of the picture belongs to a healthy tree. In the upper left corner are healthy branches on a diseased tree; lower are some diseased branches from the same tree. Photograph shows clearly the very marked contrast in size of leaves. The contrast in color was equally marked.

Magnolia, Del., August 27, 1888. Reduced to about one-fortieth natural size; *i. e.*, tree about 16 feet high.

IX. Peach trees by the highway near Rising Sun, Del., orchard of E. H. Bancroft in background.

Right tree healthy; left one in second year of the disease.

August 27, 1888. Reduced to about one fifty-fourth; *i. e.*, diseased tree about 14 feet high.

X. Tree seven years old; first diseased in 1887; cut back severely to remove yellows. Whole top covered next season with a dense growth of much branched, dwarfed, and badly diseased shoots.

Orchard of George H. Gildersleve, Rising Sun, Del., G. D. Jackson, tenant. August 27, 1888. Reduced to about one-twentieth natural size.

XI. Last stage of peach yellows. The tree in the foreground died in the fall of 1886 or spring of 1887. The branched wiry shoots on the larger limbs are often the last indication of vitality. Trees in background were all badly diseased.

Clayton, Del., August 28, 1888. Orchard No. 8 of this report. Reduced to about one thirty-fifth; *i. e.*, tree about 18 or 20 feet high.

XII. East side of an eight-year old orchard of 65 acres *entirely ruined* by yellows. The trees on 15 or 20 acres (foreground) were cut down in August, 1888, preparatory to plowing the field for wheat. I did not see one healthy tree in the whole orchard.

August 28, 1888, farm of Samuel Townsend, near Townsend, Del.

XIII. Stump the World, or Old Mixon, peaches from orchard No. 17 of this report (see Map III).

The left-hand peach (1) was green and healthy. The right-hand peach (2), from a neighboring tree, was red-spotted and prematurely ripe. Dover, Del., August 20, 1888. About natural size; *i. e.*, the longest diameter of the right-hand peach was $2\frac{1}{2}$ inches.

XIV. Healthy peach shoot. Strictly comparable with No. II. Orchard of C. C. Clark, Ann Arbor, Mich., March, 1888. Reduced to about one-fifth natural size.

XV. Healthy terminal shoot. Strictly comparable with right-hand branch of Nos. II and XIV, with 1 of No. IV, and with 1, 3, and 4 of No. XXXVII. From a healthy tree in the orchard of Joseph McDaniel, Dover, Del., August 20, 1888 (see Map III). Reduced to about seven twenty-fourths natural size, the largest left-hand leaf being 8 inches long and 2 inches broad.

XVI. Terminal peach shoots collected May 8, 1888, from a strong growing five-year-old tree at Vineyard, Ga., by J. D. Husted. Photographed May 13. Believed to be yellows. In each tuft or rosette from four to six very small secondary branches were pushing from the base of the shoot-axis. The buds on the naked parts of the two stems were dead. Reduced to one-third natural size.

XVII. Same as No. XVI, but collected one month later. From J. N. Harris, Griffin, Ga., June 15, 1888. Photographed June 17. Reduced to about one-third natural size; *i. e.*, the length of the main axis, including the terminal shoot, was 15 inches.

XVIII. Same as No. XVII. Terminal shoot-axis stripped of most of its leaves and enlarged (to twice natural size) to show manner of branching. Primary, secondary, and tertiary branches developed within three months, although during that time the primary shoot-axis only elongated $2\frac{1}{2}$ inches.

XIX. Diseased shoots. Same as XVI and XVII, but late in the season and entirely dead. The main axis, as far as (a), grew in 1887. The entire growth of 1888 is represented by the feeble terminal and side shoots: 1 and 2 are parts of the same shoot-axis. From J. D. Husted, Vineyard, Ga., November 13, 1888. About two-thirds natural size.

XX. Diseased shoots from a New Jersey tree set two years in Georgia. The yellows appeared the second year, most of the winter buds pushed in October or November, and the foliage was fresh and plentiful when first received, but was withered and fallen in great part when photographed. No spring foliage remained. From J. D. Husted, Vineyard, Ga., November 13, 1888. About two-thirds natural size.

XXI. Same as XX, but from another tree in the same orchard. The leaves are all from winter buds, which pushed in October or November and were fresh when first gathered. From J. D. Husted, Vineyard, Ga., November 15, 1888. Not quite two-thirds natural size.

XXII. Diseased shoots from an apricot. Believed to be of the same nature as the diseased growths of the peach. The branches grew out separately, erect, from the same main limb. Garden of John R. Nicholson, Dover, Del., September 28, 1887. Reduced to one-third natural size.

XXIII. Healthy shoot from a sound apricot. Comparable with No. XXII. Garden of John R. Nicholson, Dover, Del., September 28, 1888. Reduced to one-third natural size.

XXIV. East part of an orchard on the "Cassiday" or "Peach Blossom" farm in Cecil County, Md., 6 miles southwest of Cecilton, on Sassafras River. The trees are only eight years old, but were cut down in the summer of 1888 on account of yellows, having become entirely worthless. Photographed November 7, 1888.

XXV. East side of "Cassiday" orchard, looking west. Trees ruined by yellows, but many yet standing (see text).

XXVI. Peach tree set two years and entirely healthy. From same orchard as VI. Strictly comparable with No. XXVII. This tree was not larger than other healthy trees in same orchard or than similar trees in the orchard from which XXVII came. Reduced to about one-fifteenth natural size. Dover, Del., November 6, 1888.

XXVII. Same as XXVI, but badly dwarfed by root-aphides. Tree set two years; foliage badly "Frenched" in August. From southeast corner of orchard No. 18, Map VII. Reduced to about one-fifteenth natural size. Still Pond, Md., November 1, 1888. Uninjured trees in this orchard were as large as XXVI.

XXVIII. Healthy seedlings which were inoculated with diseased buds August 12, 1887, and developed yellows in the summer of 1888. Photograph made November 3, 1888; *i. e.*, fifteen months after the inoculation. Trees unmistakably diseased.

1. Diseased growth from the inserted bud (*a*). The top part of the growth was cut away in the nursery some time between August and November.

2. Diseased growth from the inserted bud (*a*). Tree entirely dead.

3. Diseased growth from the inserted bud (*a*) and also from the stock (*b b b*). Top part of growth from inserted bud was cut away in nursery some time between August and November.

Reduced to five-sevenths natural size.

XXIX. Healthy seedlings which were inoculated with diseased buds August 12, 1887, and developed yellows in the summer of 1888. Photograph made November 3, 1888; *i. e.*, fifteen months after the inoculation. Trees unmistakably diseased.

1. Inserted bud (*a*) dead. Five diseased growths from the stock.

2. Diseased growths from the inserted bud (*a*) and also from the stock (*b b*). The top part of the branched growth from the inserted bud was cut away in the nursery some time between August and November.

3. One diseased growth from the inserted bud (*a*) and also five or six from the stock. The inserted bud made a feeble growth (1 inch) and died early.

Reduced to about seven-eighteenths natural size.

XXX. Healthy seedlings which were inoculated with diseased buds August 12, 1887, and developed yellows in the summer of 1888. Photograph made November 3, 1888; *i. e.*, fifteen months after the inoculation. Trees unmistakably diseased.

1. Inserted bud dead, no growth (*a*). Two diseased growths from the stock (*b b*).

2. Inserted bud dead, no growth (*a*). Two diseased growths from the stock, the foliage of which was not wilted or fallen away when the tree was taken from the nursery.

3. Two buds inserted, the growth from one (*a*) apparently healthy but not robust; the growth from the other (*a'*) diseased and dead. Six diseased growths were also found on the stock below the lowest inserted bud, four of which are here shown. Reduced to about seven-fifteenths natural size.

XXXI. Healthy and diseased tree from the same nursery. Stocks of the same age and quality and budded at the same time; *i. e.*, August, 1887. Photograph made November 3, 1888.

1. Inserted bud healthy. *Tree healthy.* Like its fellows, but smaller than the average. Many trees budded at same time had twice as great a diameter.

2. Inserted buds diseased. *Tree diseased.* One of the two inserted buds (*a, a'*) failed to grow; the other grew into a diseased shoot. The growths from the stock (*b, b', b''*) were diseased; but *b''* was apparently healthy until autumn, when most of its winter buds began to grow under the influence of the disease (compare with I, XX, XXI, and Fig. 2 of XXXVII). The branching diseased tops of *a'* and *b'* were cut

away in the nursery some time between August and November. Reduction about one-half. Only about one-third of entire length is here shown.

LITHOGRAPHS OF PAINTINGS FROM NATURE.

XXXII. Healthy, ripe Beers' Smock, with foliage. Orchard of Daniel Faulkner, Saugatuck, Mich., October 10, 1888.

XXXIII. Healthy ripe Beers' Smock, from orchard No. 14 of this report. September 17, 1887.

XXXIV. Beers' Smock peaches; 1 and 2 prematurely ripe; 3. Section through the same, but the flesh is not quite orange enough for this variety; 4. Green peach taken at same date from a neighboring healthy tree. Dover, Del., September 2, 1887. Healthy Beers' Smock peaches were ripe at Dover about September 17.

XXXV. Stump the World or Old Mixon peaches. From orchard No. 17 of this report. Collected August 27, 1888; 1, 2, and 3 prematurely ripe; 1 and 2 showing appearance of flesh when cut radially and tangentially; 4. Healthy green peach picked at same time from a neighboring tree. Natural size.

XXXVI. Crawford's Early peaches. From orchard of Thomas D. France, Chestertown, Md., August 3, 1888; 1 and 2 prematurely by borers (*Egeria exitiosa*, Say.); 3. Green peach from a neighboring uninjured tree. The tree from which 1 and 2 were taken had been almost completely girdled by borers. The dark spots on Fig. 1 and on right-hand peach on Plate XXXII are due to *Cladosporium*.

XXXVII. Healthy and diseased shoots. Natural size and color. Fig. 1. Section from a healthy terminal shoot, Stump the World; 2. Portion of diseased shoot from a tree in advanced stage of yellows, showing terminal bud and axillary bud beginning to grow in autumn after the ordinary foliage has fallen; 3. Section of terminal shoot from a tree badly diseased in all parts, second or third year of disease. This is strictly comparable with Fig. 1; 4. Terminal shoot from same tree as Fig. 3. Dead since spring. The shriveled appearance is not clearly shown in the figure. This figure may also be compared with Fig. 1. All from Washington, D. C. September 28, 1888.

The leaf-spots are due to the *Cercospora* (?) mentioned in the text.

L—PEACH ORCHARD OF DR. W. S. MAXWELL.

STILL POND MARYLAND

Trees set in autumn of 1882. Map showing condition on August 17, 1887, and on August 7, 1888 the "Year" was having fruit reported in 1886. This orchard was entirely removed and the field sowed to wheat in the fall of 1888.

- 6. Lighter than the 2. drainage area
- 7. Very little change in elevation of river
- 8. Set back grade stage
- 9. Marsh
- 10. Bottom land covered in silt with a very soft,Neal ground

PERSONAL: ON

- Tree dead or poor health poor
- Seed taken for analysis
- Tree with ~~poor~~ in 1887
- Tree taken for analysis
- Tree ~~dead~~ ~~poor~~ in 1887
- Tree ~~dead~~ ~~poor~~ in 1887 and leaves dropped in 1888
- Health tree
- More healthy, although surrounded for two years by 7 trees and almost



1016

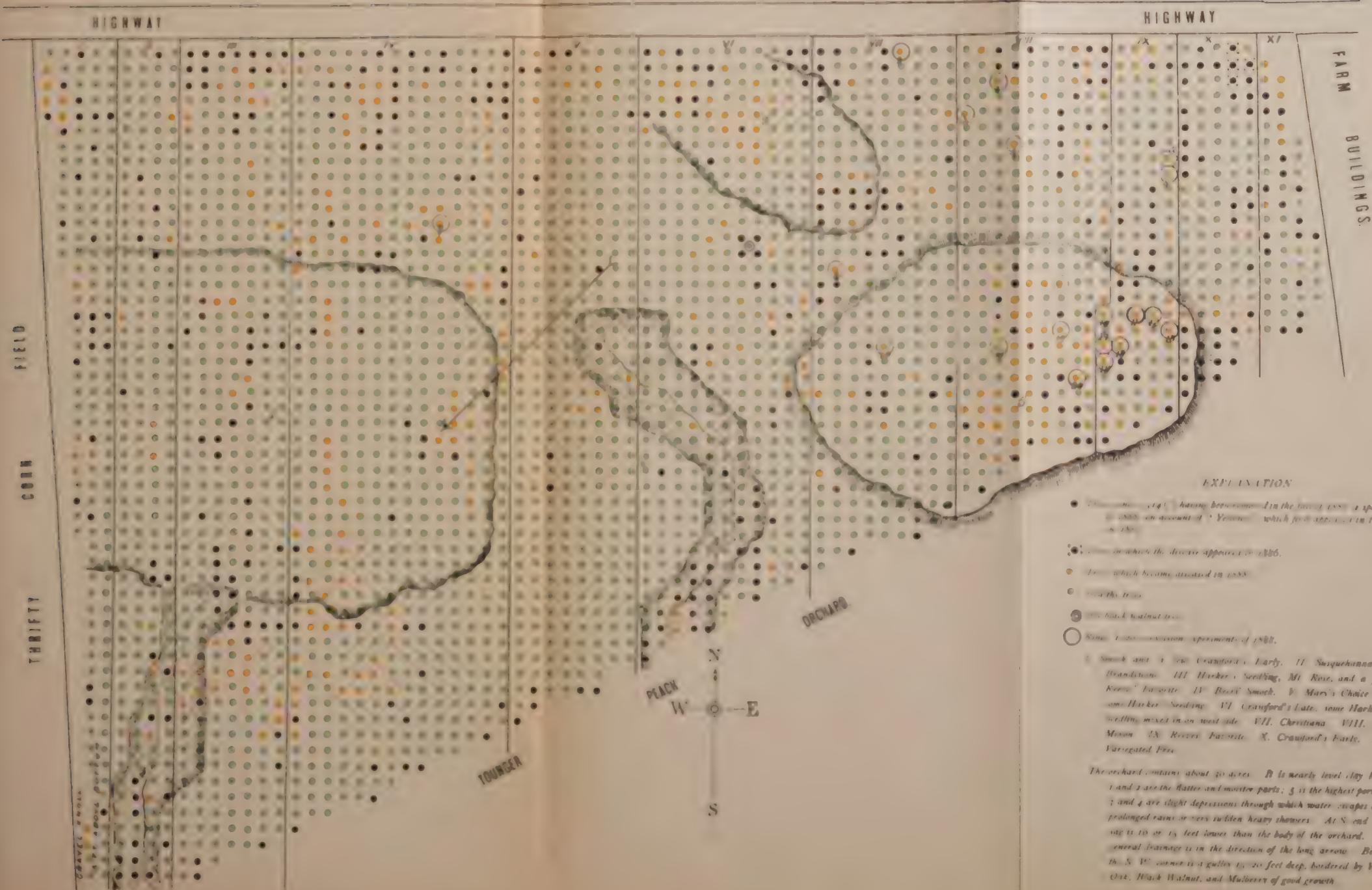
PEACE

ORCHARD

II—PEACH ORCHARD OF F. H. HARPER.

STILL POND, MARYLAND.

Trees set in 1881. Map showing condition of orchard on August 6, 1888, "Yellows" having first appeared in the summer of 1886 in four trees.



III—PEACH ORCHARD OF J. FRANK DENNEY,

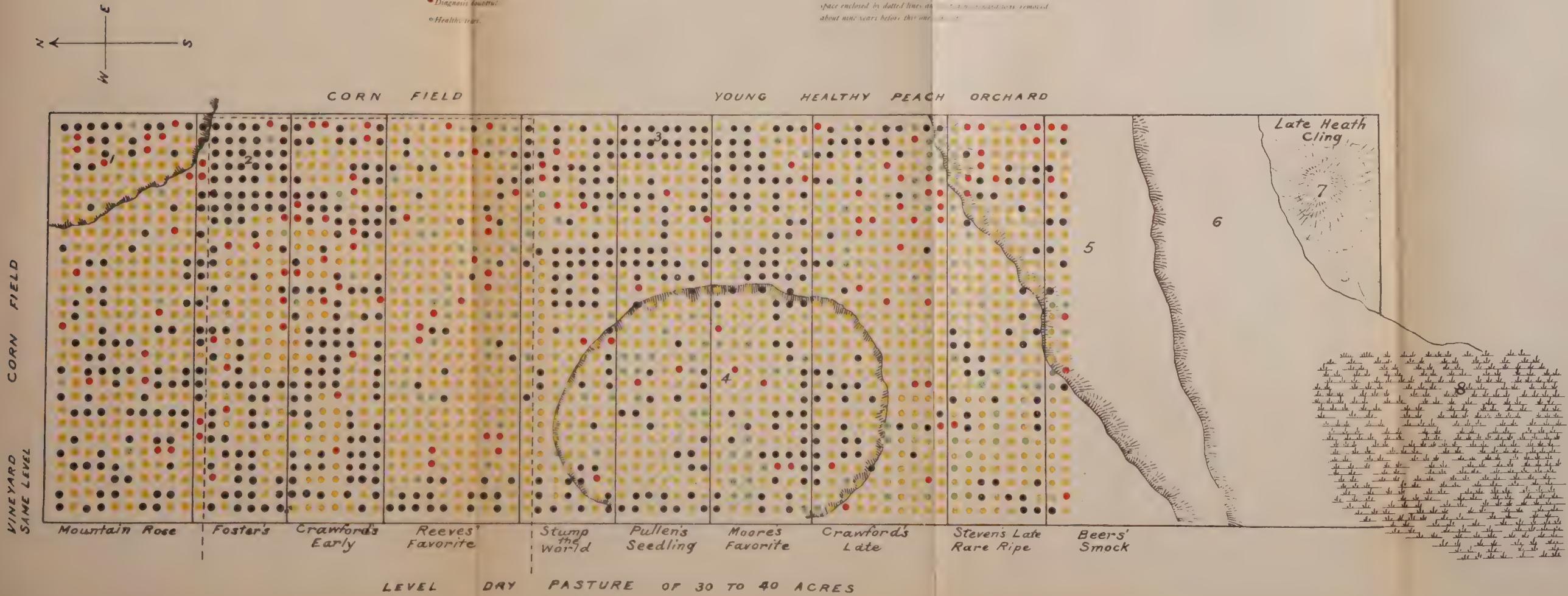
LEIPSIC, DELAWARE.

Trees set in spring of 1881. Map showing condition on September 12, 1887, "Yellows" having been present four years.

EXPLANATION

- Trees cut down or pulled out prior to 1887—mostly on account of "Yellows."
- Trees which were found diseased by "Yellows" in 1887, a majority said not to have been affected in 1886.
- Diagnosis doubtful.
- Healthy trees.

1 Bottom 2 and 7, spots where the disease is said to have appeared first—in 1884. 4. Four or five acres of master earth, a very little lower than the body of the orchard. 5. Gentle slope, 100 feet with 100 trees. 6. Beers' Smock. 7. Gravelknoll, with 42 trees badly diseased. 8. Enclosure marked. From the space enclosed by dotted lines about nine years before this one 100 trees were removed.



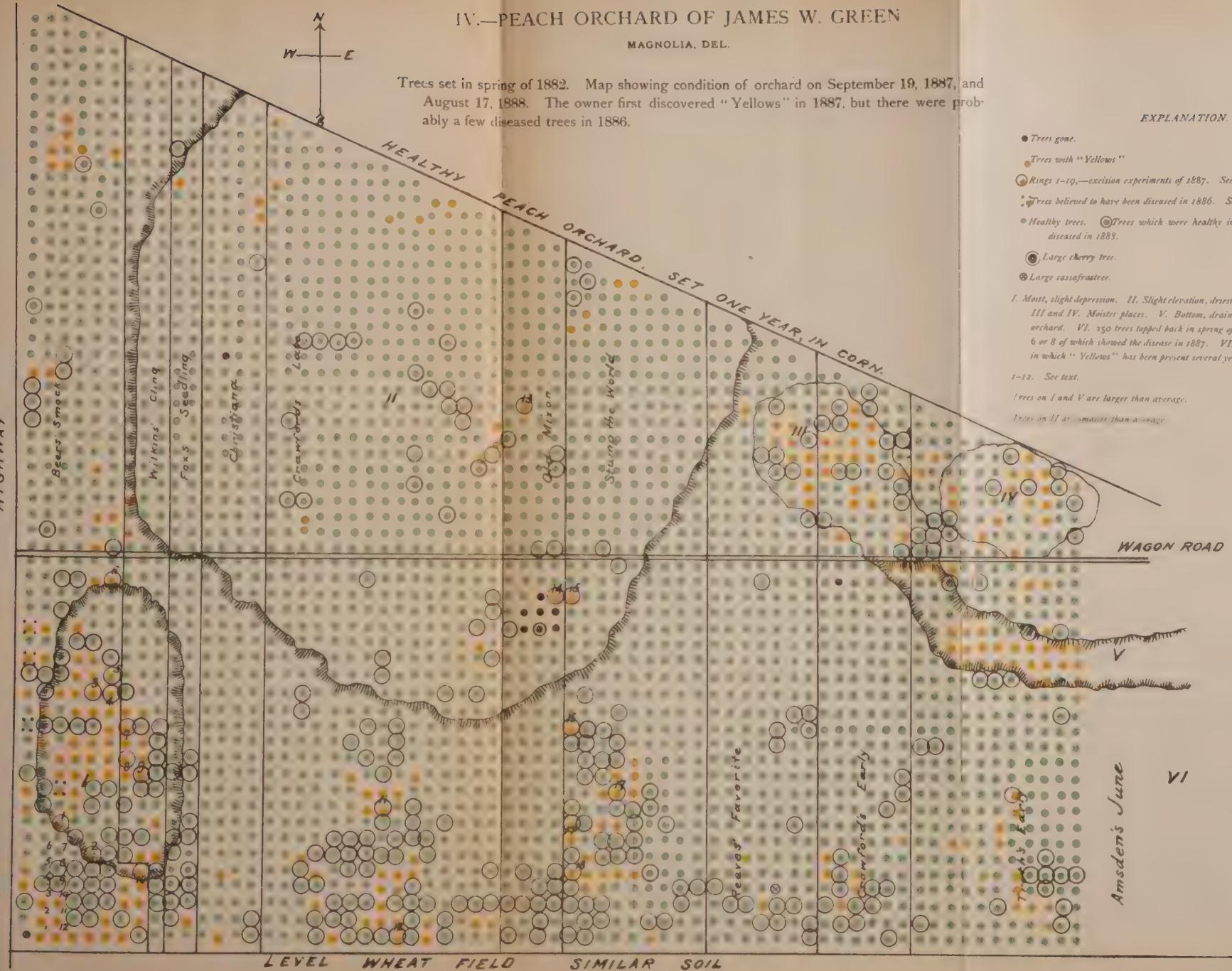
IV.—PEACH ORCHARD OF JAMES W. GREEN

MAGNOLIA, DEL.

Trees set in spring of 1882. Map showing condition of orchard on September 19, 1887, and August 17, 1888. The owner first discovered "Yellows" in 1887, but there were probably a few diseased trees in 1886.

VII.

LEVEL FIELD SIMILAR TO ORCHARD



EXPLANATION

V.—PEACH ORCHARD OF COL. D. P. BARNARD,

RISING SUN, DEL.

Trees set in spring of 1885. Map showing condition on September 7, 1887, and August 21, 1888, the "Yellows" having first appeared in 1887.

EXPLANATION

- Trees good
- Trees diseased by "Yellows" in 1887
- ◎ Undead tree, from which buds were taken for inoculation. See text.
- ◆ Disease in 1887, doubtful
- Disease in 1888
- Healthy trees
- ◎ Trees which were healthy in 1887, and became diseased in 1888

I, II, III. See text

- 1. New ground set in trees of same size, a few of which are diseased
- 2. Slight depression, would be pile of dead limbs from an older diseased orchard to the S.E. of bottom of a strawstack. 5. Residence. 6. Cess pit. 7. Tenant's house. 8. Garden. 9. 10, 11, 12. See text

CONTINUATION
OF ORCHARD

RASPBERRY PLANTATION

1

E

S

8

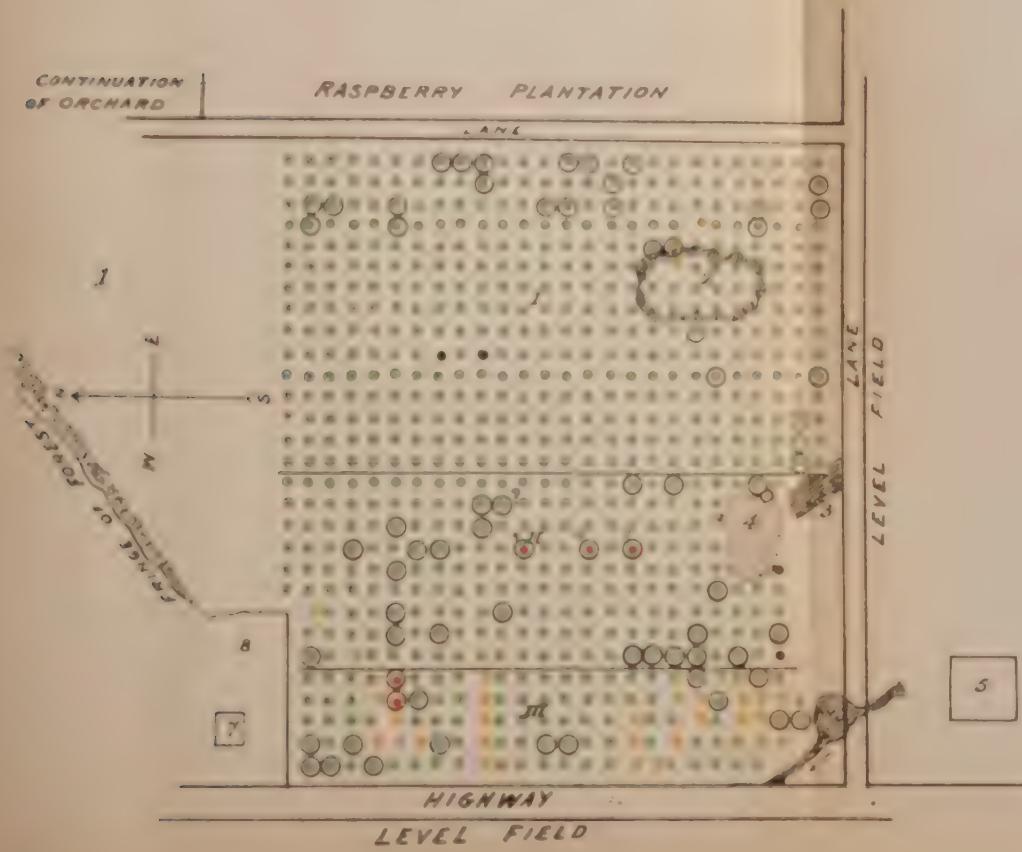
7

HIGHWAY
LEVEL FIELD

LANE

LEVEL FIELD

5



VI—PEACH ORCHARD OF JOSEPH McDANIEL.

DOVER, DELAWARE.

Map showing condition on August 20, 1888, the trees having been set in the Spring of 1884.

Total trees, 1,777. Number now diseased by "Yellows," 887.

The first stage of evolution was in the sand and may be
seen in the valley of the River Taff, near Cardiff. East of
Mynydd y Gelli, a low range of hills about 1700
feet high, the valley floor is at 400 feet. On the
slopes of the hills are numerous small, rounded,
isolated groups of trees, the *Mixed woodland* of Mr. R.
and Mr. G. Edwards. Here Mr. Ross and his
party found the first *Quercus ilex* in the valley, and
a *Quercus ilex* 100 ft. high.

EXPLANATION.

- Trees good
- Trees with "Yellow"
- Hairy grass.
- Dragonous doubtful

The pears at the top of the mat indicate the moment when selected trees raised in each bushel were in 1863, 1865, or 1868. The disease was not in evidence 1868, but it may have been affected in 1862. The orchard is less than 1000 ft. above the sea level and the soil is rather sandy. In the direction of the arrow is a dry creek bed, about 100 ft. long. It is a natural drainage, and the water disappears 18 ft. above the rest of the orchard.

Old Peach Orchard — removed in 1888.



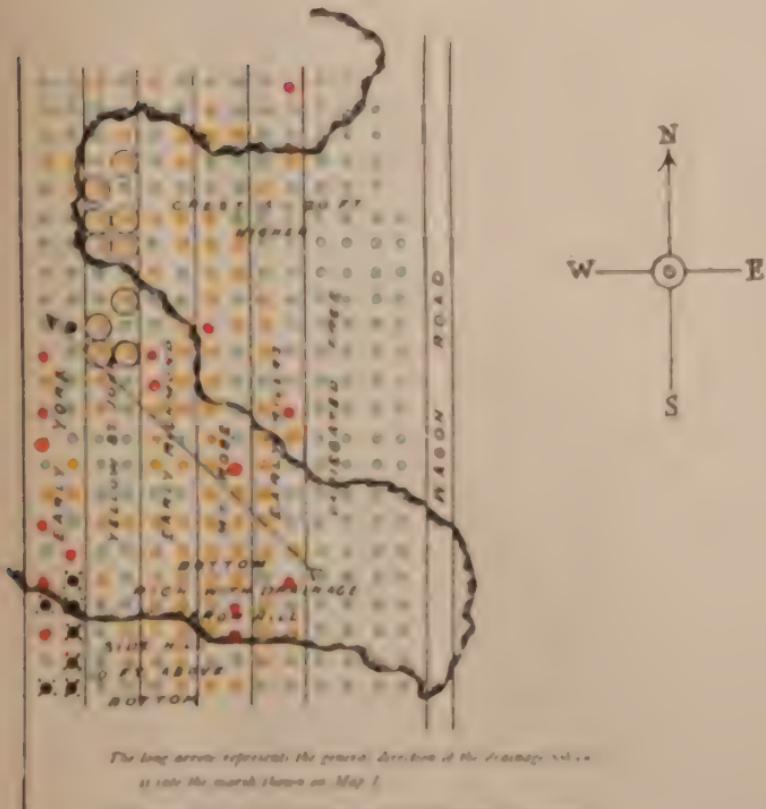
VII.—PEACH ORCHARD OF DR. W. S. MAXWELL.

STILL POND, MARYLAND.

Map showing condition on August 7, 1888. Trees 3 years old, except the Variegated Free which are one year younger. "Yellows" first appeared in this orchard in 1887, when it was two years old, in S. W. corner. The south side of this orchard is at foot of a high hill, bearing diseased orchards, the north side joins on to Orchard No. 1. See Map I.

EXPLANATION

- Trees green.
- Trees diseased in Aug., 1887, and gone in 1888.
- Trees found diseased in 1888, many of them badly, that being the first year they fruited.
- Tree sent to T. J. Merrill.
- Healthy trees.
- Disgorged orchard.



The long arrow represents the general direction of the drainage, which is into the marsh shown on Map I.

The younger trees on Road side are free from "Yellows" fairly ripe and the condition of the whole orchard in Aug. 1887, with exception of the diseased trees in the S. W. corner. Some of the trees in S. E. corner are, however, rather diseased by root aphides.



R. I.
170
N. J.
21,289
DEL.
44,456
MD.
54,333

PEACH-YELLOWS.

1860.

1861.

PEACH AND OF PEACH-YELLOWS.

UNITED STATES.

Estimated area of the peach and peach-yellow trees
in the United States, 1860.











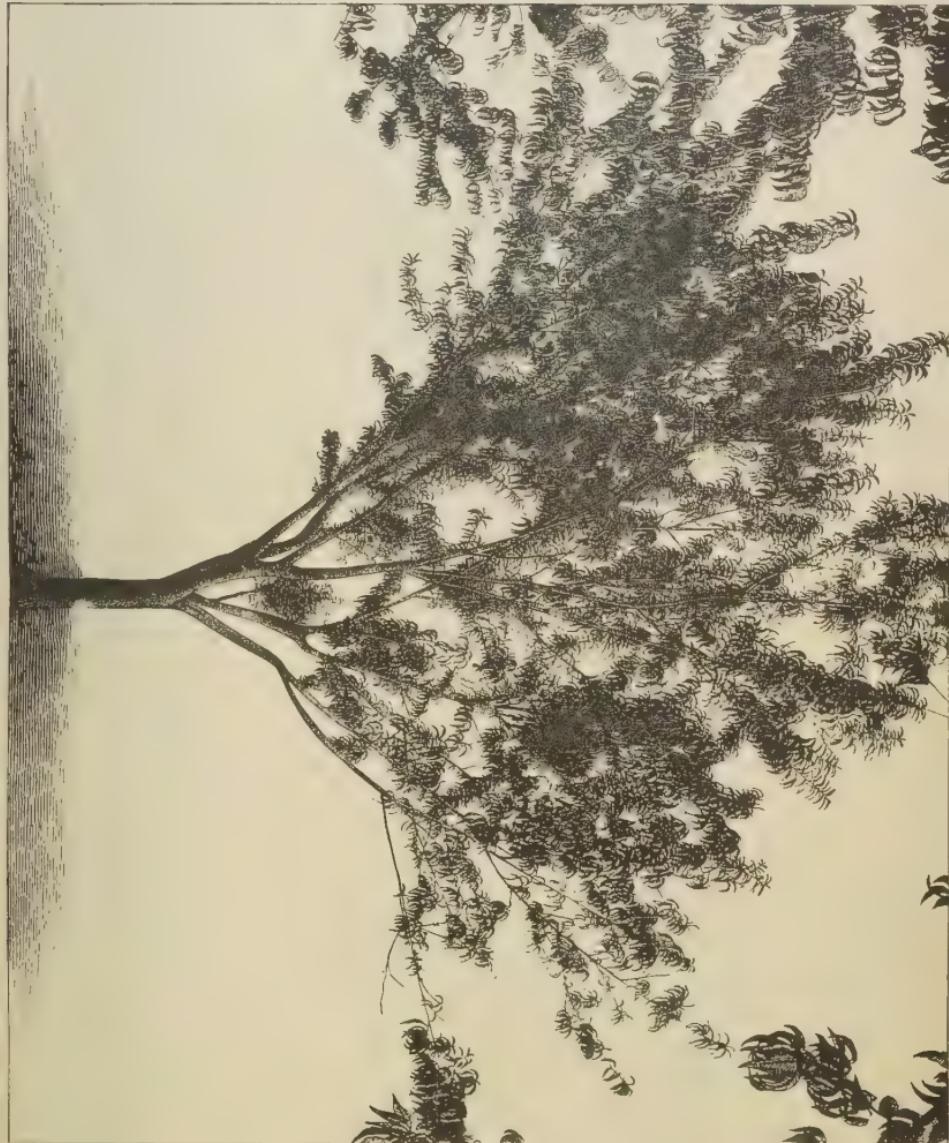




DISEASED TREE.—SET SIX MONTHS.

(Delaware.)

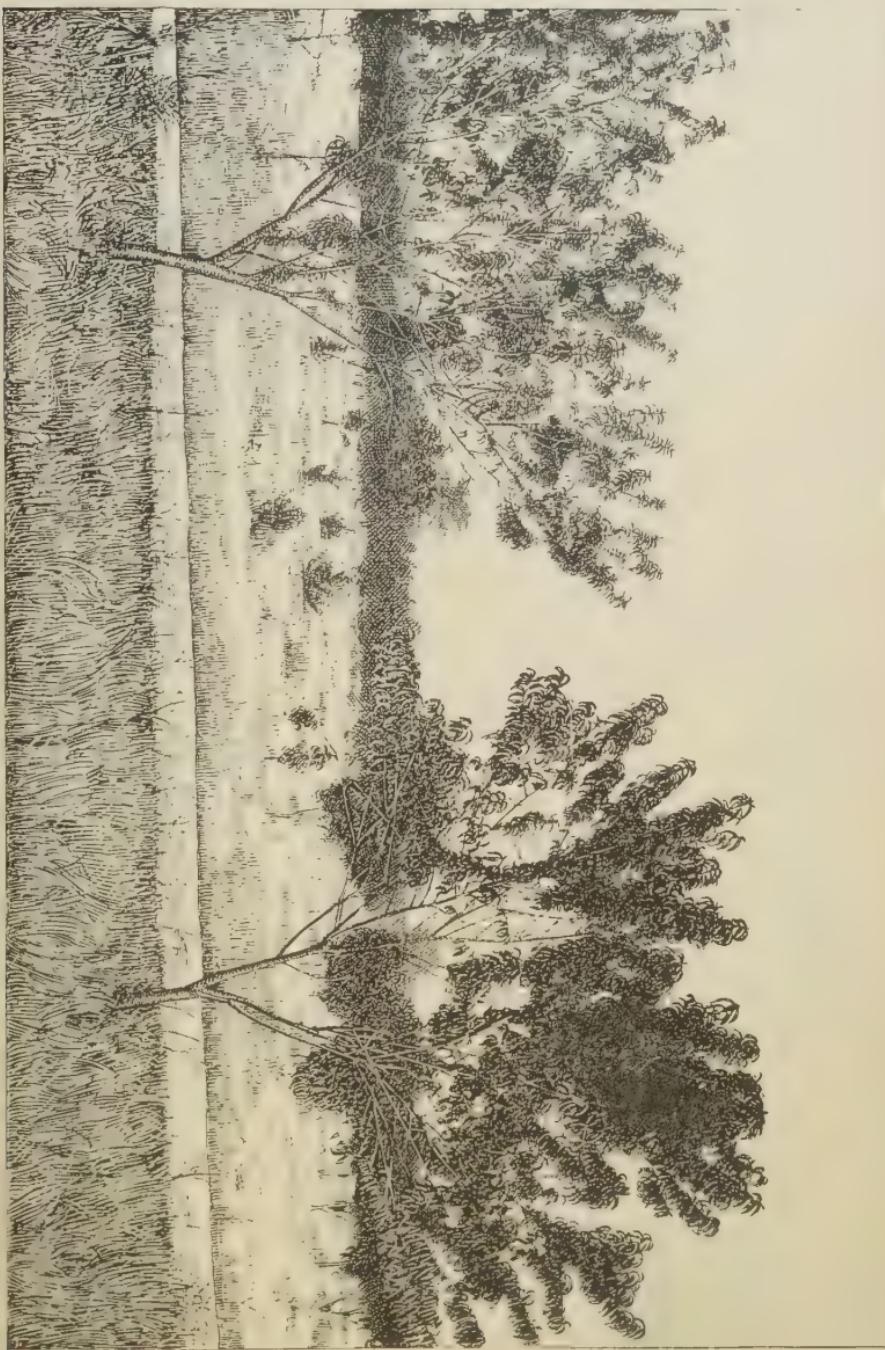


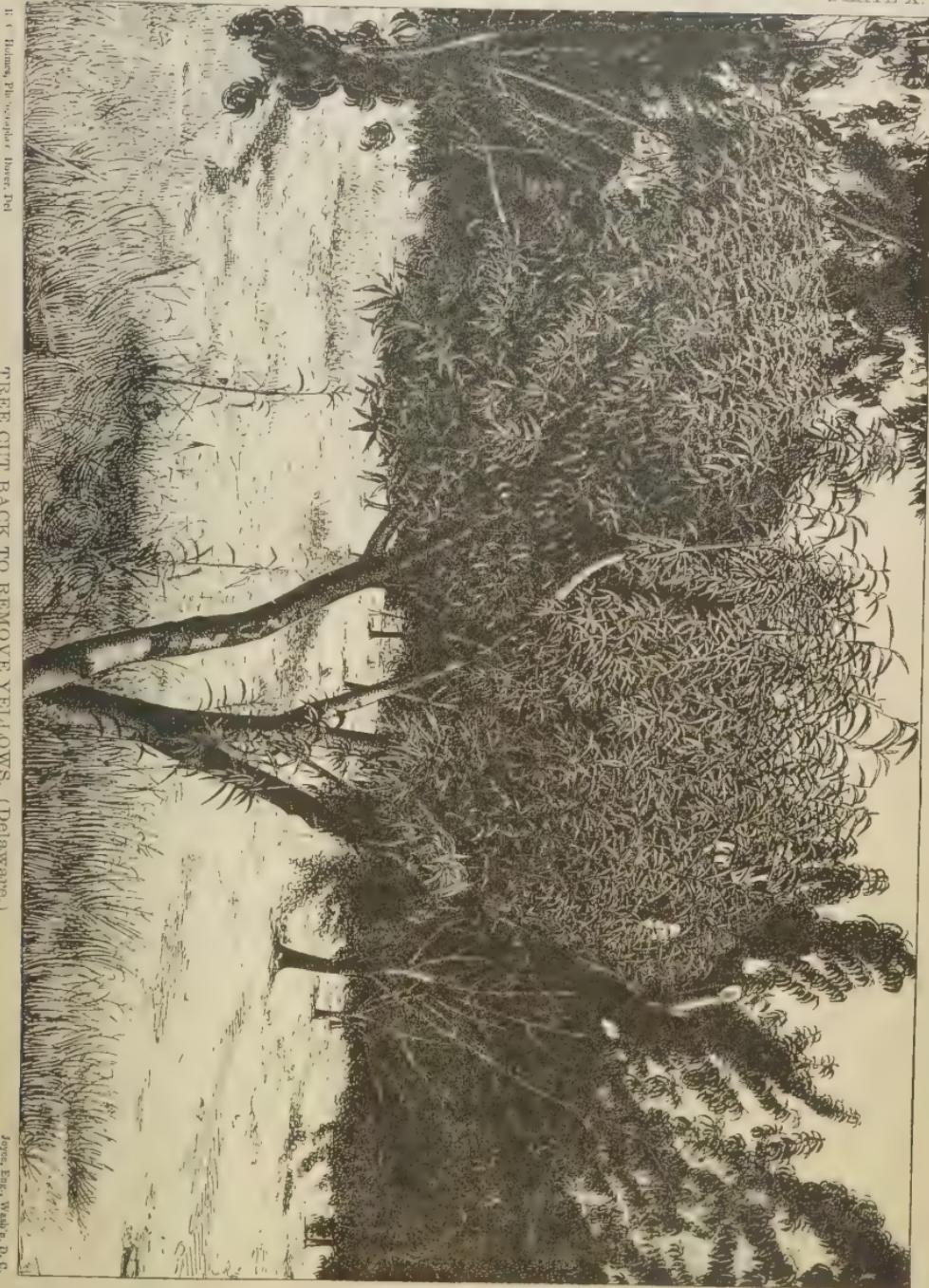


R. C. H. line, Photogr. Dr. C. D. I.

DISEASED AND HEALTHY TREE. (Delaware.)

M. J. Lipp, Eng., Wash., D. C.







DELAWARE ORCHARD RUINED BY YELLOWS.



1.—HEALTHY PEACH. 2.—PREMATURE PEACH.

(Delaware.)

1

2







HEALTHY TERMINAL SHOOT.

(Delaware.)





DISEASED PEACH SHOOT
(Georgia.)



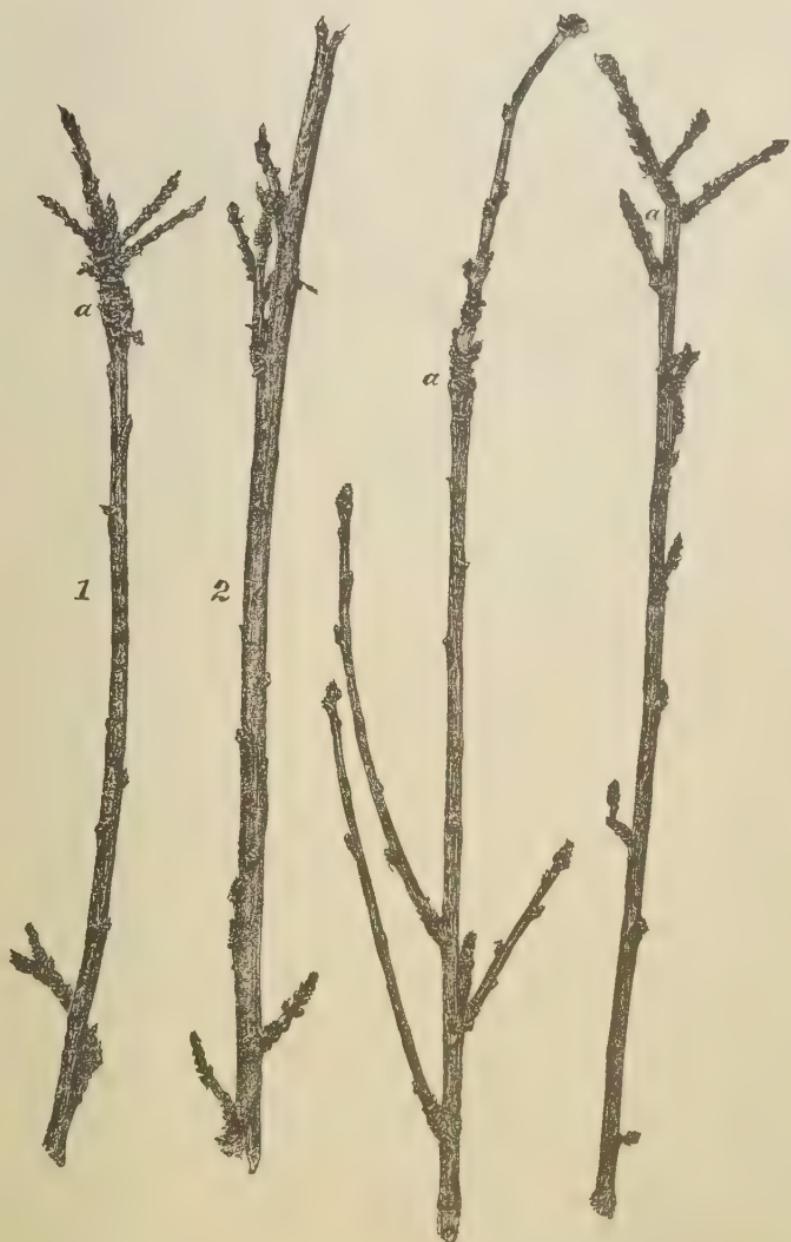
Gibson, Photographer, Ann Arbor, Mich.

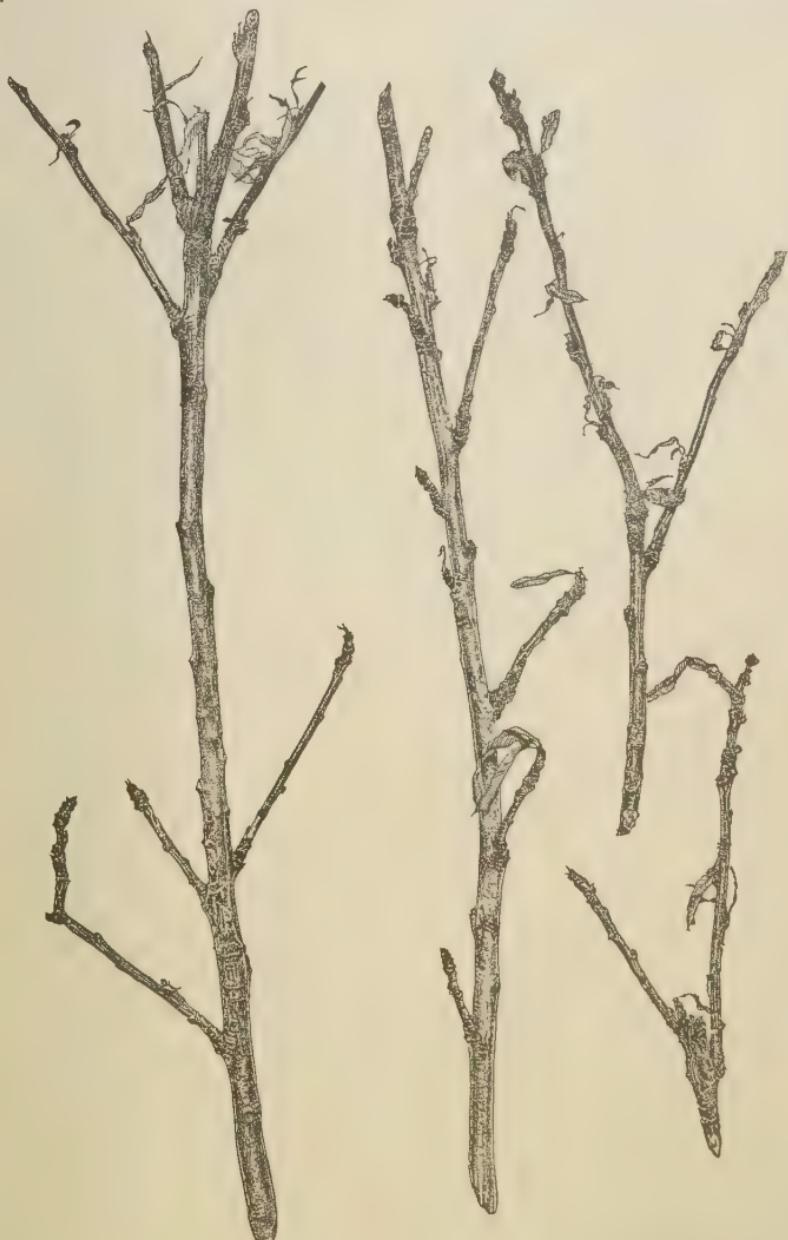
M. Joyce, Eng., Wash'n, D. C.

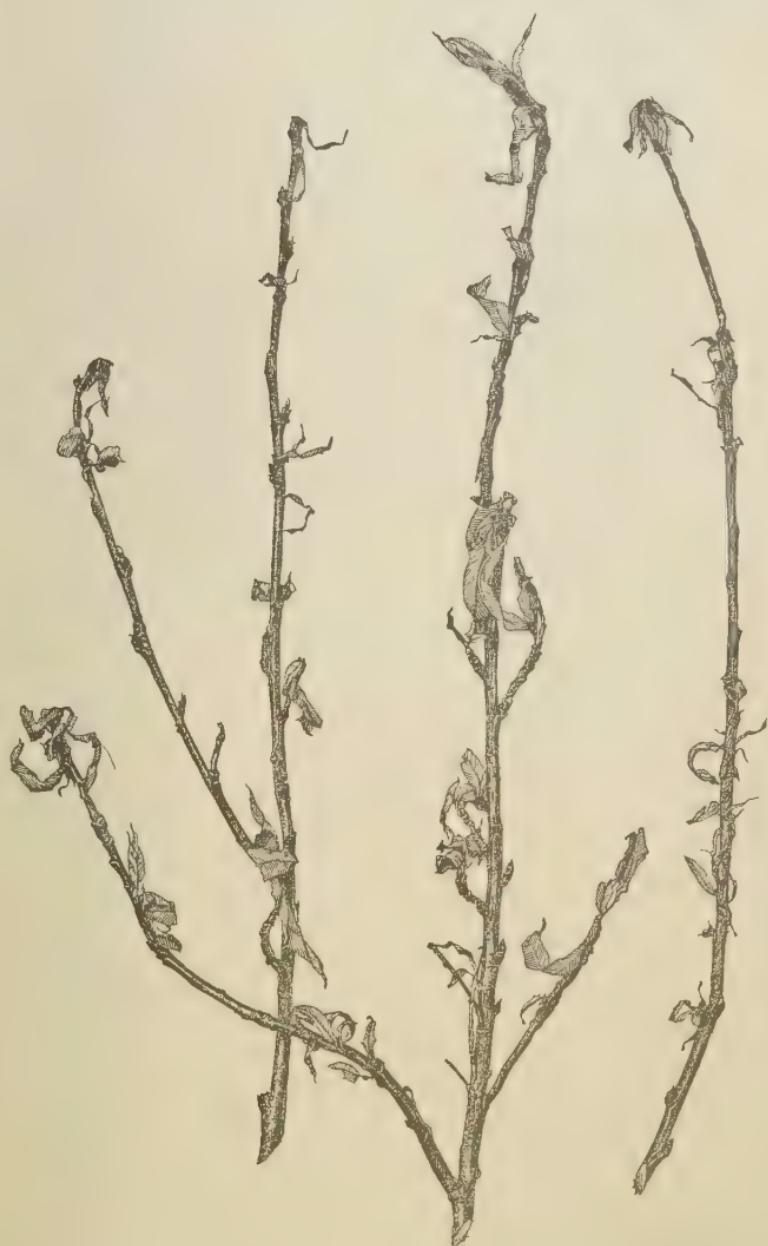
DISEASED PEACH SHOOT.

Enlargement of one tuft of Plate XVII

(Georgia.)

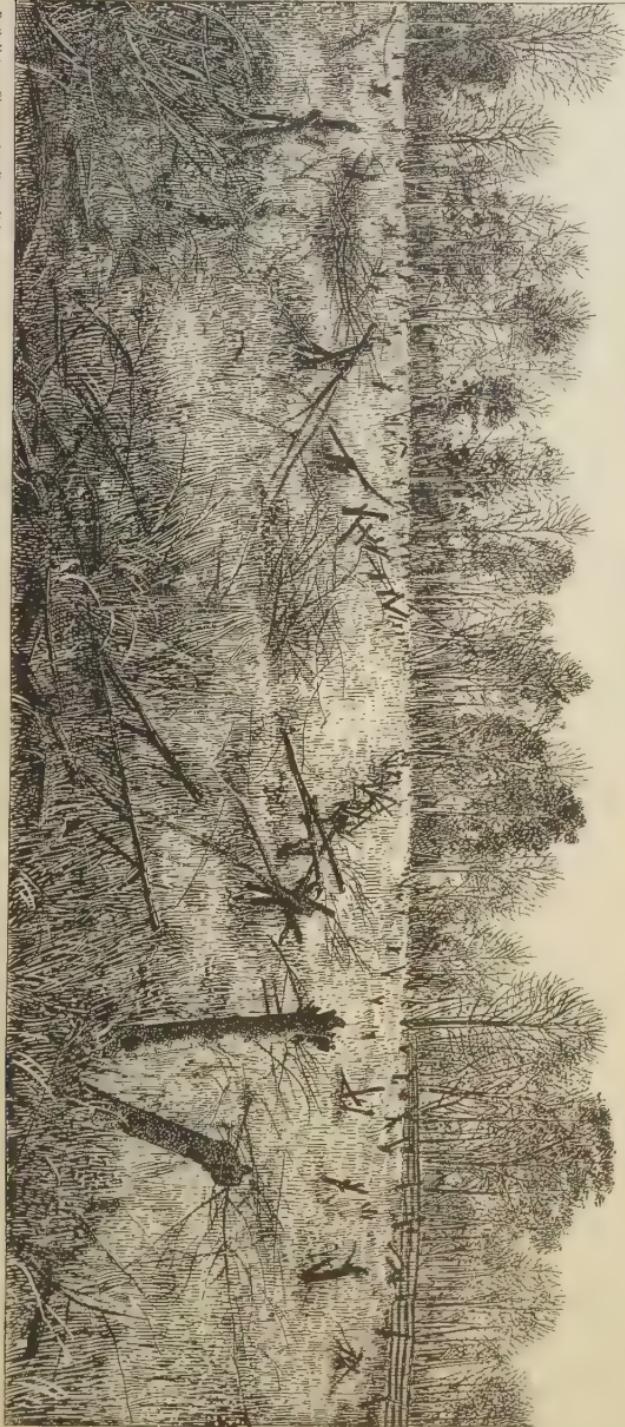




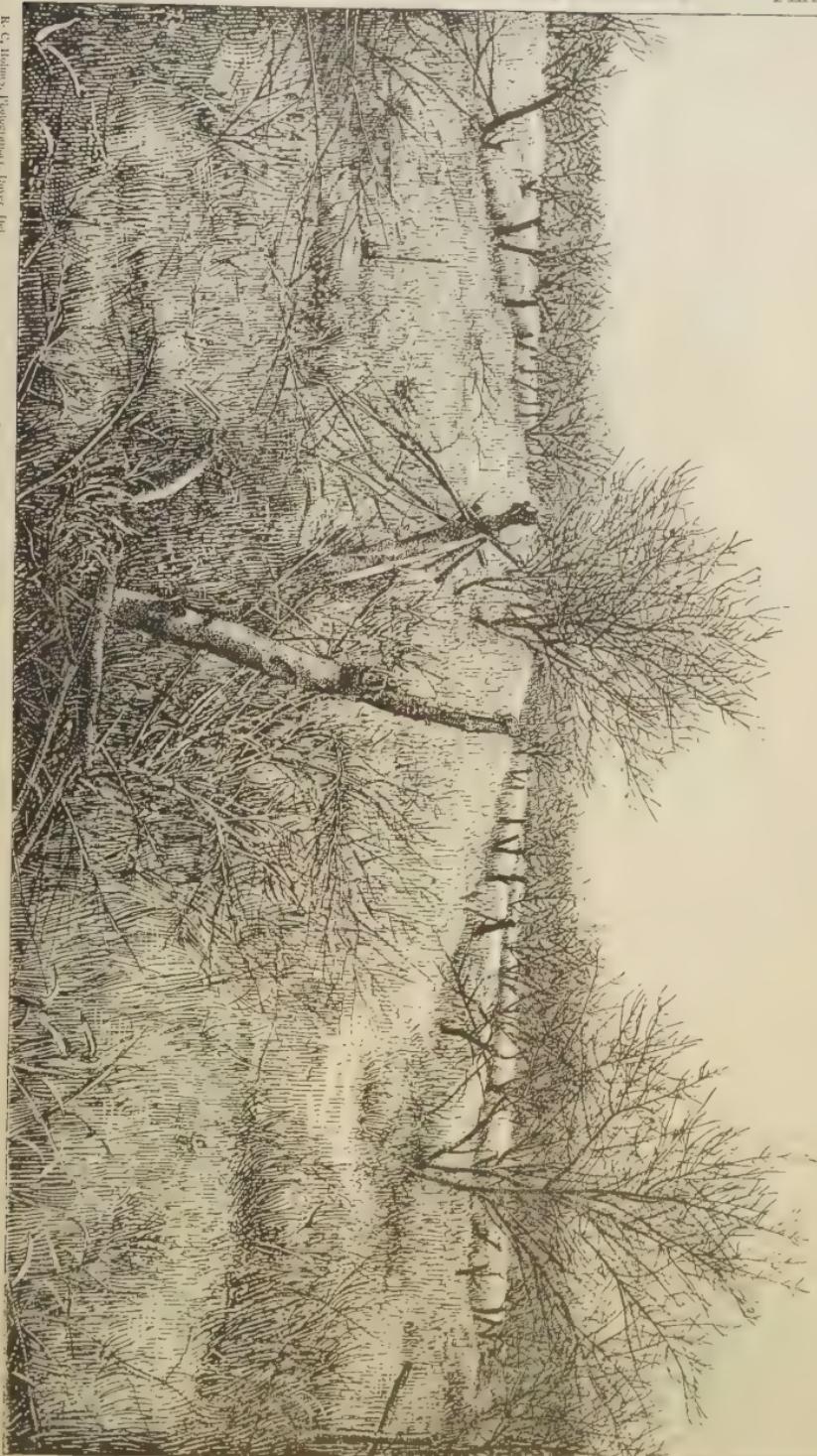


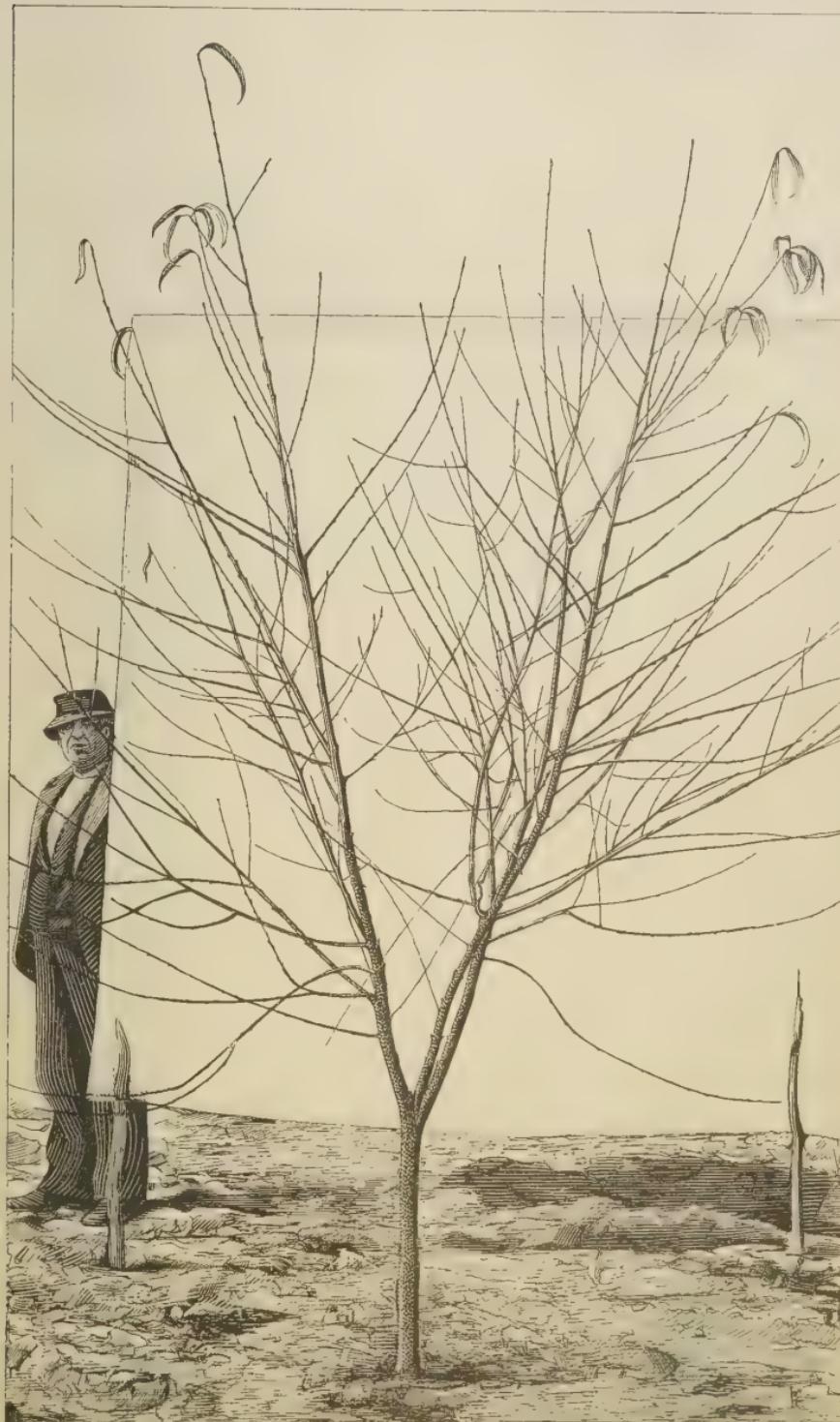






MARYLAND ORCHARD RUINED BY PEACH YELLOWS.



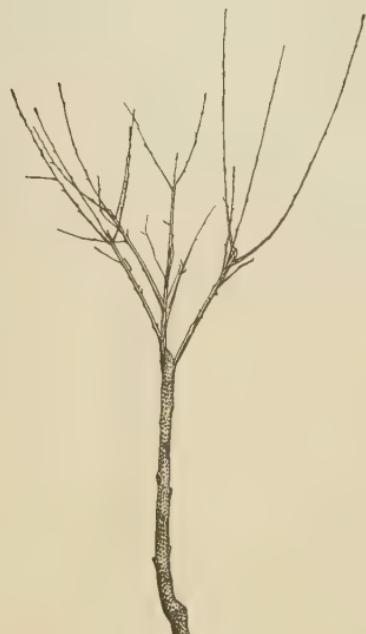


R. C. Holmes, Photographer, Dover, Del.

M. Jones, Engr., Wash'n, D. C.

HEALTHY PEACH TREE.—SET TWO YEARS.

(Delaware.)

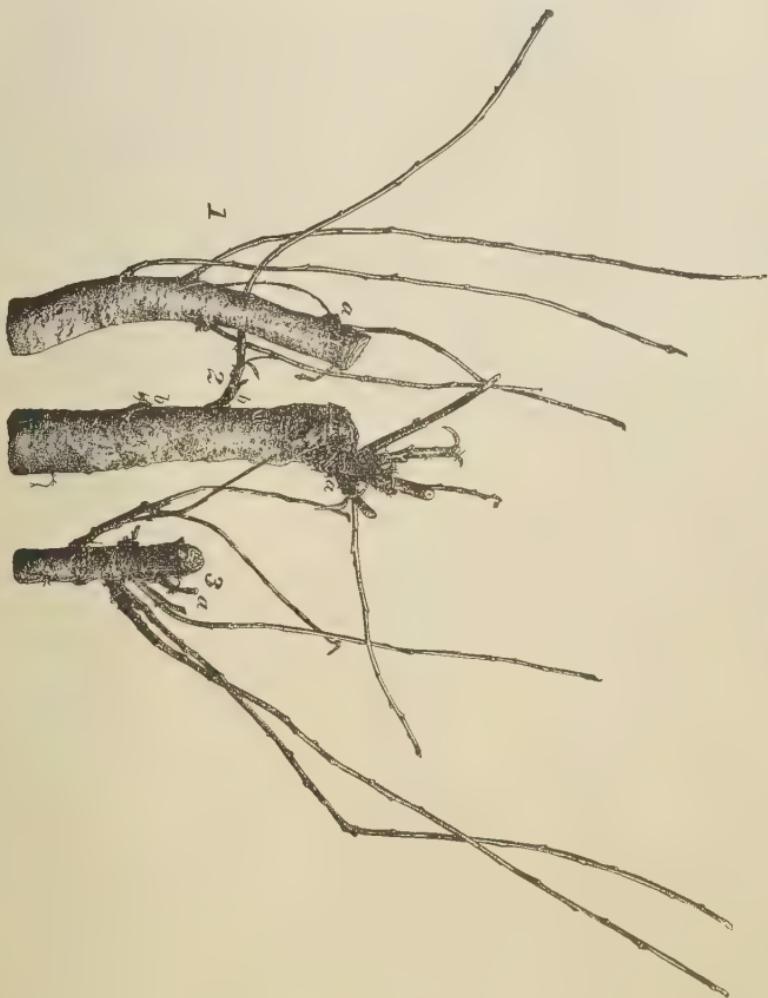


PEACH TREE.—SET TWO YEARS.

Stunted by Root Aphides.

(Maryland.)











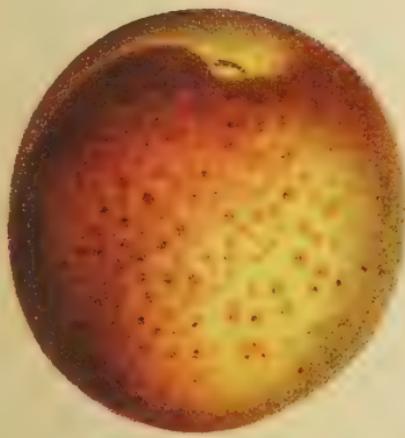




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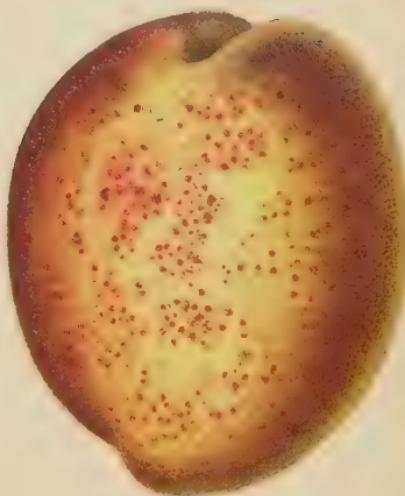


6



7















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